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(12) **United States Patent**
Shimada

(10) **Patent No.: US 11,921,440 B2**
(45) **Date of Patent: Mar. 5, 2024**

(54) **DEVELOPER SUPPLY DEVICE, DEVELOPMENT DEVICE, AND IMAGE FORMATION APPARATUS**

(71) Applicant: **Oki Electric Industry Co., Ltd.**, Tokyo (JP)

(72) Inventor: **Shingo Shimada**, Tokyo (JP)

(73) Assignee: **Oki Electric Industry Co., Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **18/064,642**

(22) Filed: **Dec. 12, 2022**

(65) **Prior Publication Data**

US 2023/0273547 A1 Aug. 31, 2023

(30) **Foreign Application Priority Data**

Feb. 25, 2022 (JP) 2022-027852

(51) **Int. Cl.**
G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/0886*** (2013.01); ***G03G 15/0872*** (2013.01); ***G03G 15/0875*** (2013.01); *G03G 2215/068* (2013.01); *G03G 2215/0692* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/0875; G03G 15/0886; G03G 15/0872; G03G 2215/0692; G03G 2215/068
USPC 399/258, 262; 222/DIG. 1
See application file for complete search history.

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Primary Examiner — Robert B Beatty
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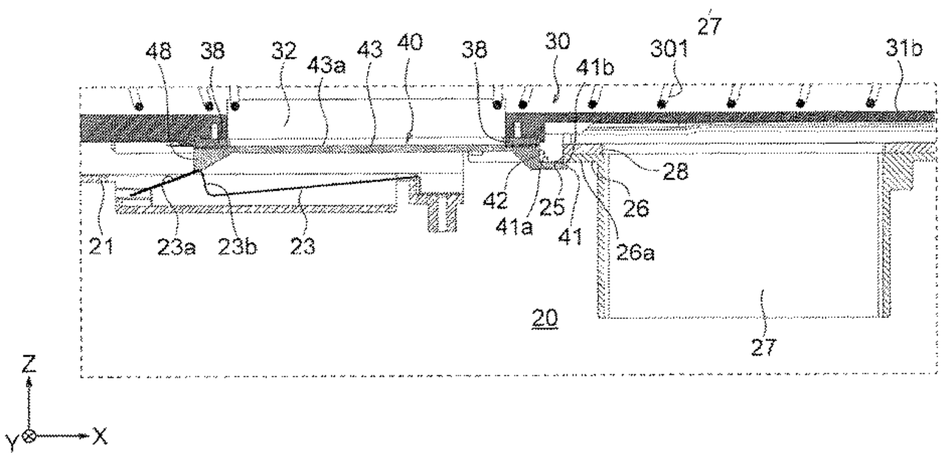
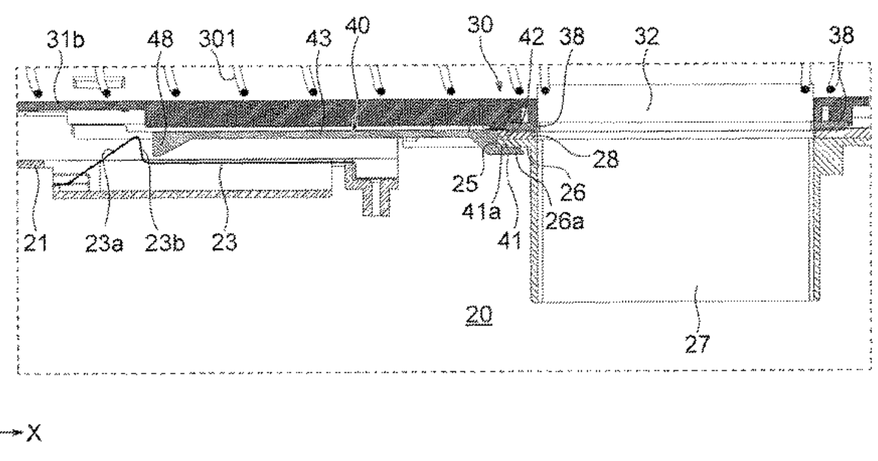
(57) **ABSTRACT**

A developer supply device according to an embodiment may include: a developer container; and a developer container holder to which the developer container is to be attached in a first direction. The developer container includes: a shutter movable between a closing position to close a supply port of a housing thereof and an opening position to open the supply port; and a sealing member provided between the housing and the shutter. The shutter includes: a cover portion including a cover surface configured to close the supply port; and a protruding portion projected in the first direction from the cover portion and provided at a position spaced apart from the cover surface to a side of the developer container holder. The developer container holder includes an engagement portion to be engaged with the protruding portion in a state where the developer container is attached to the developer container holder.

12 Claims, 45 Drawing Sheets





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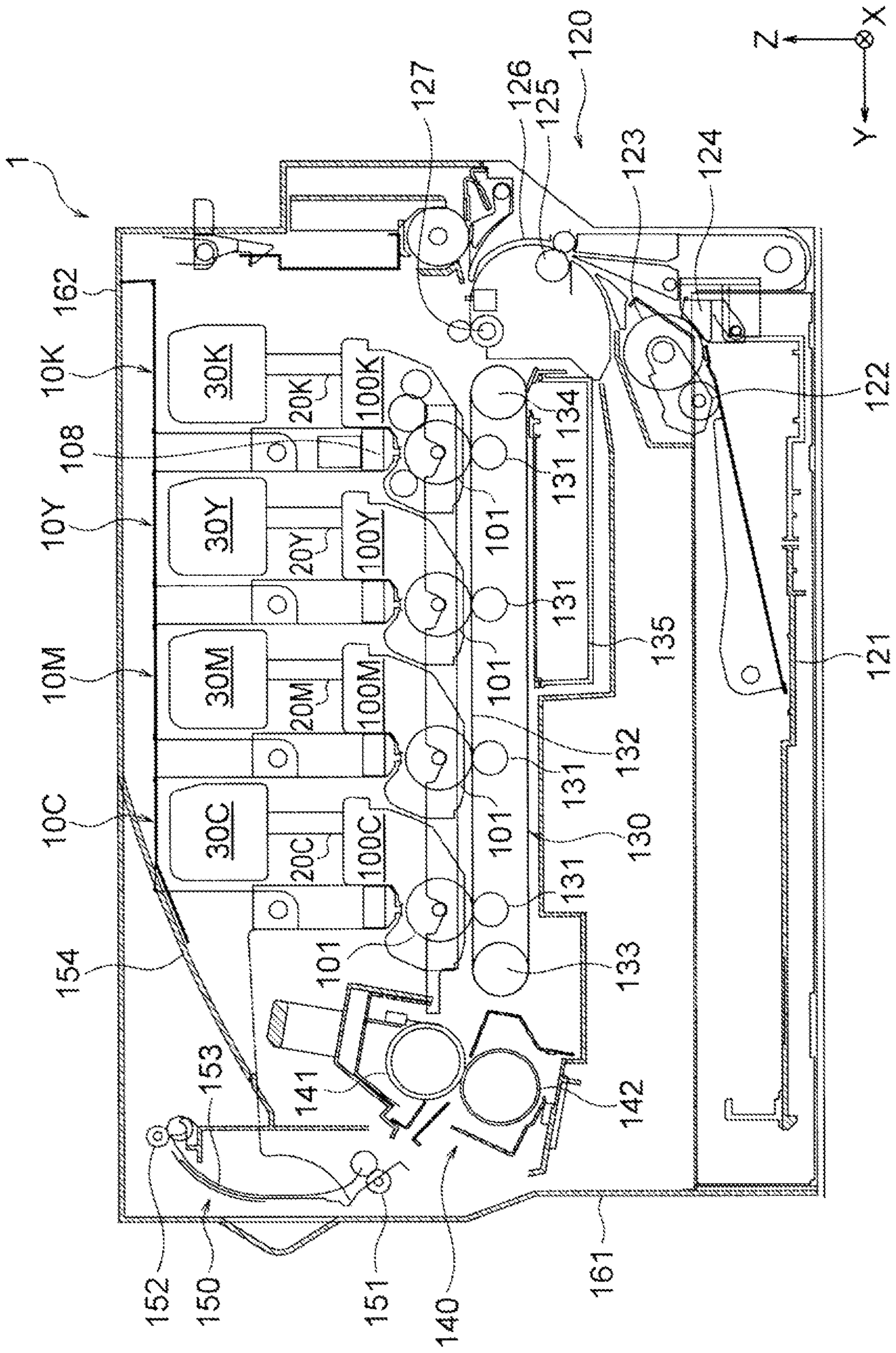
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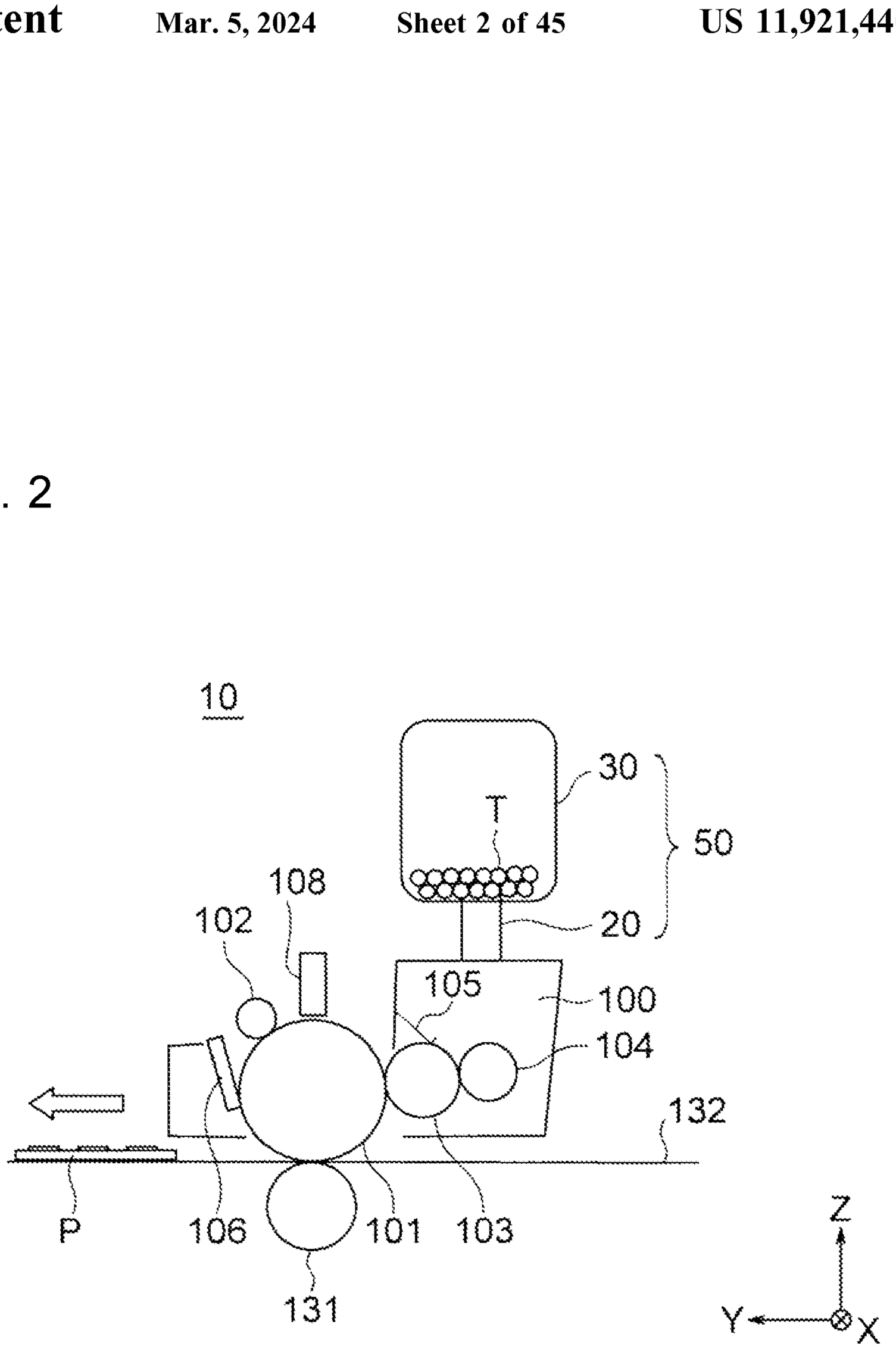
FIG. 1

FIG. 2



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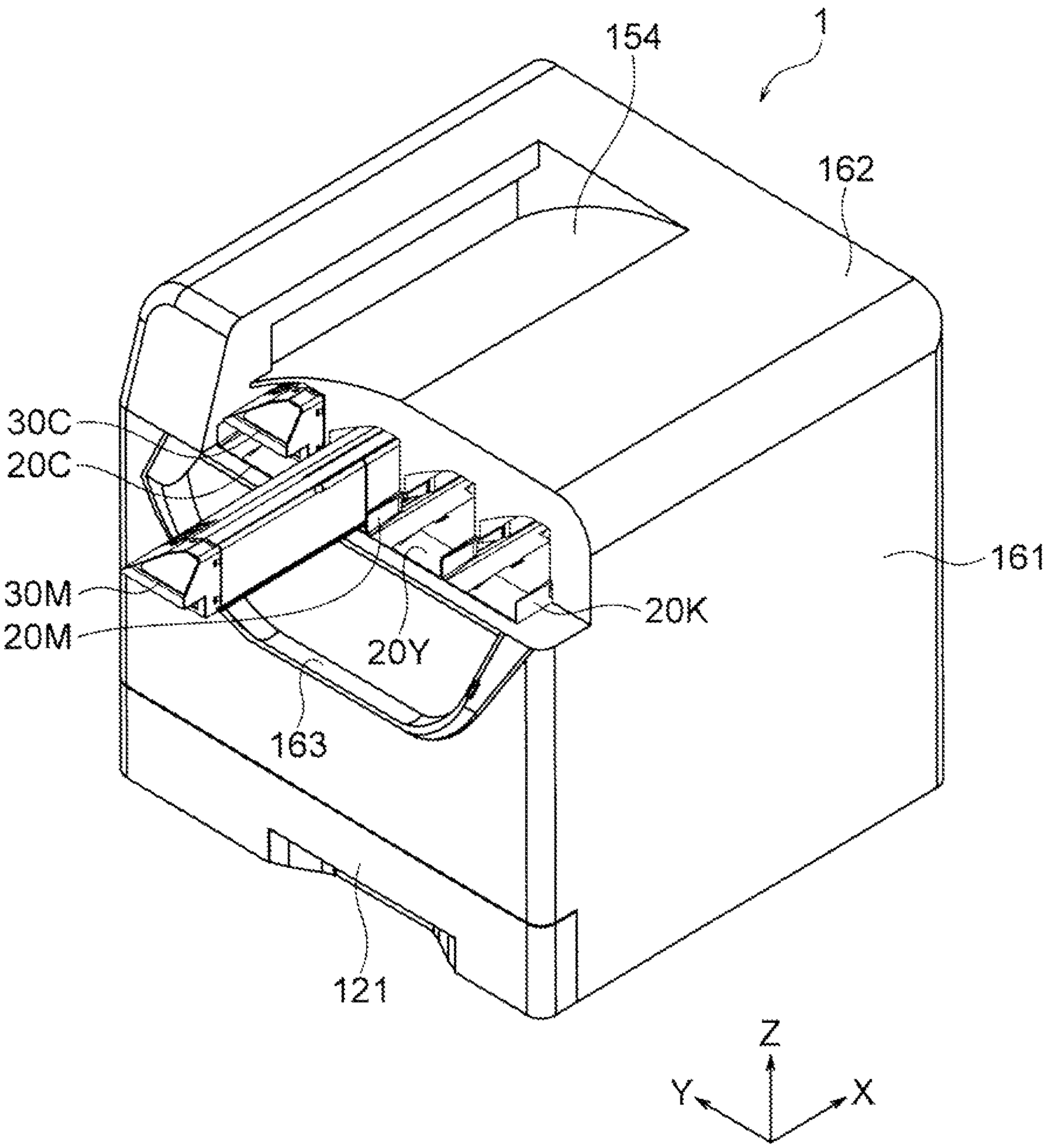


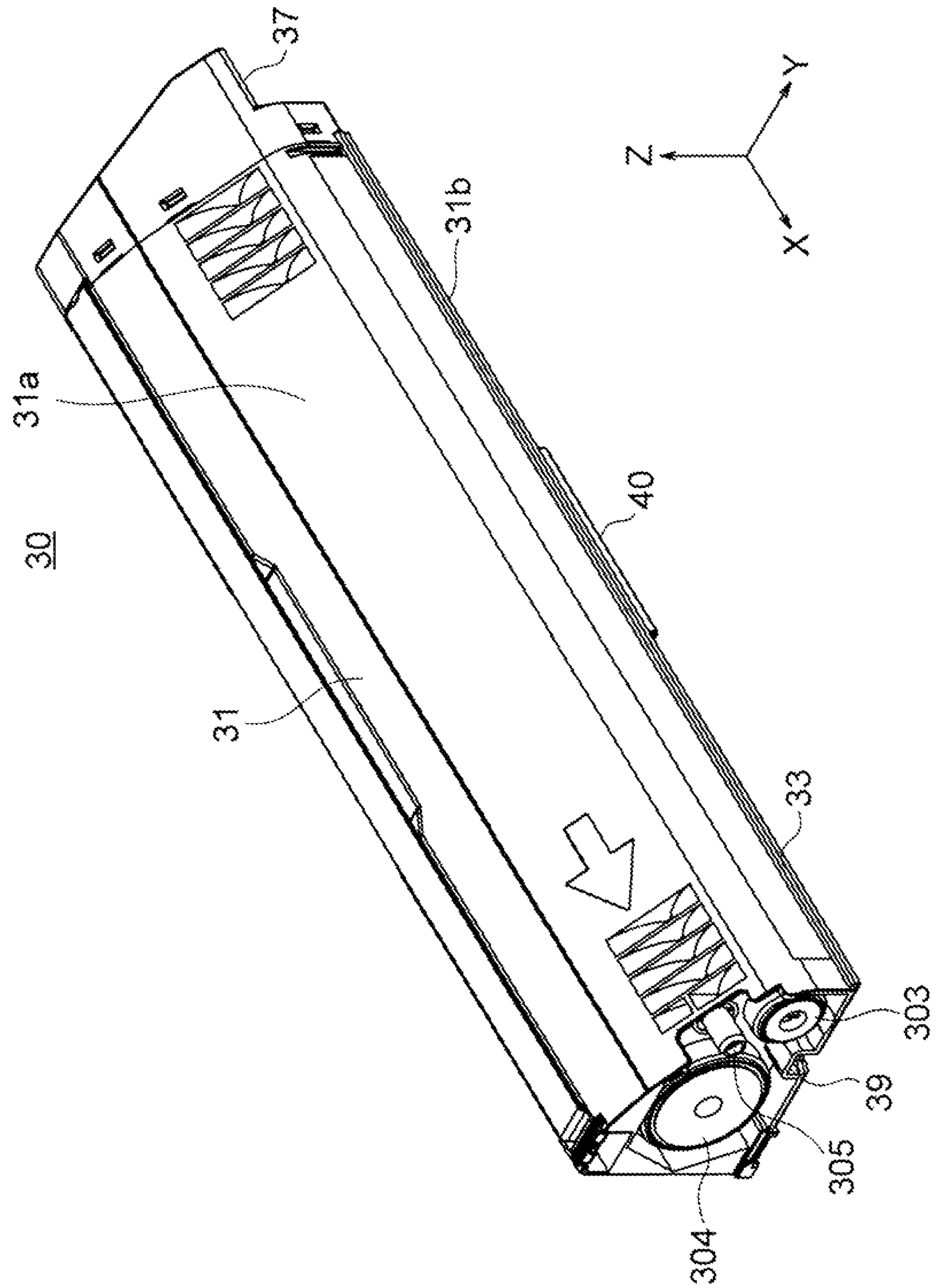


FIG. 4

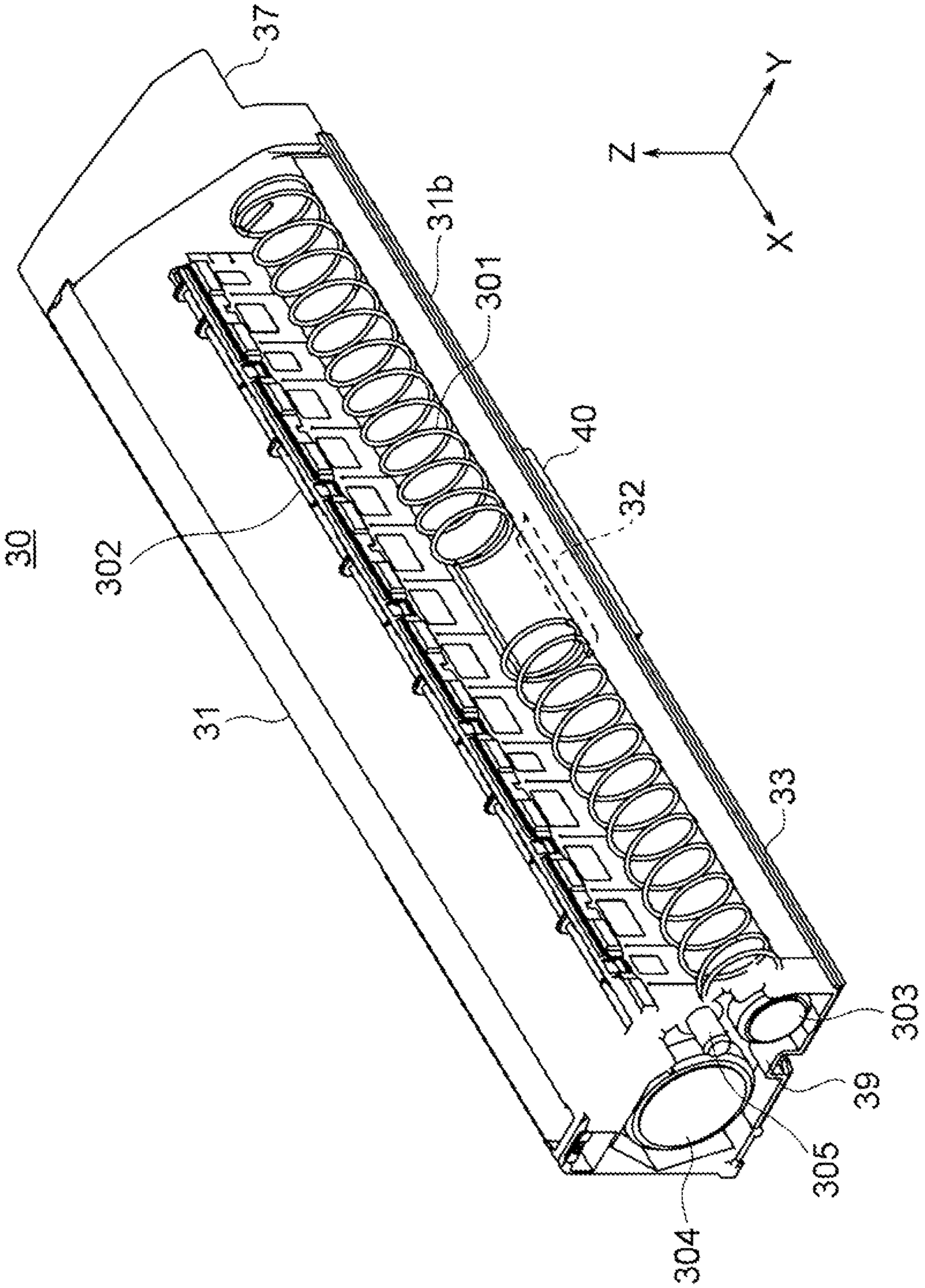
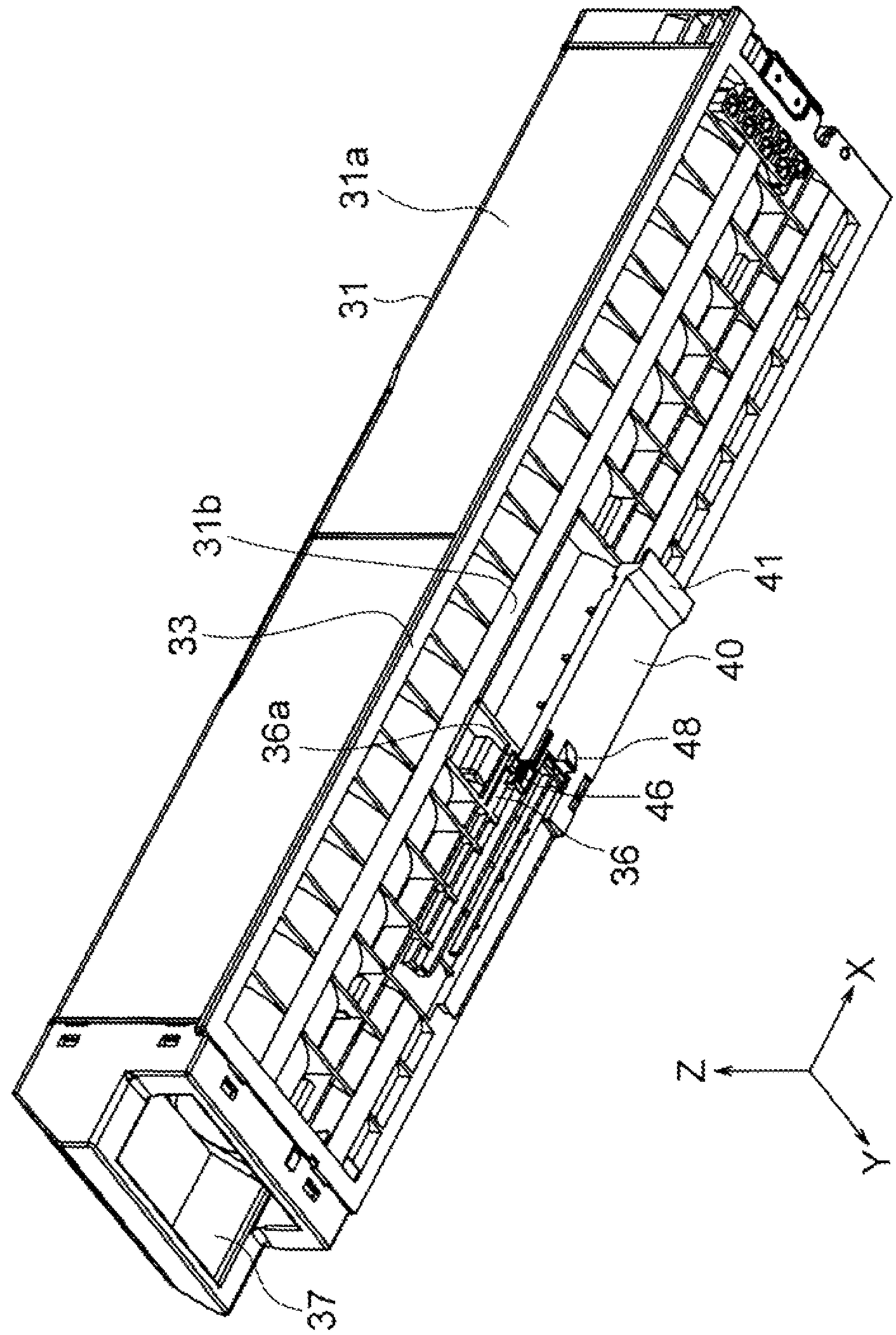


FIG. 5



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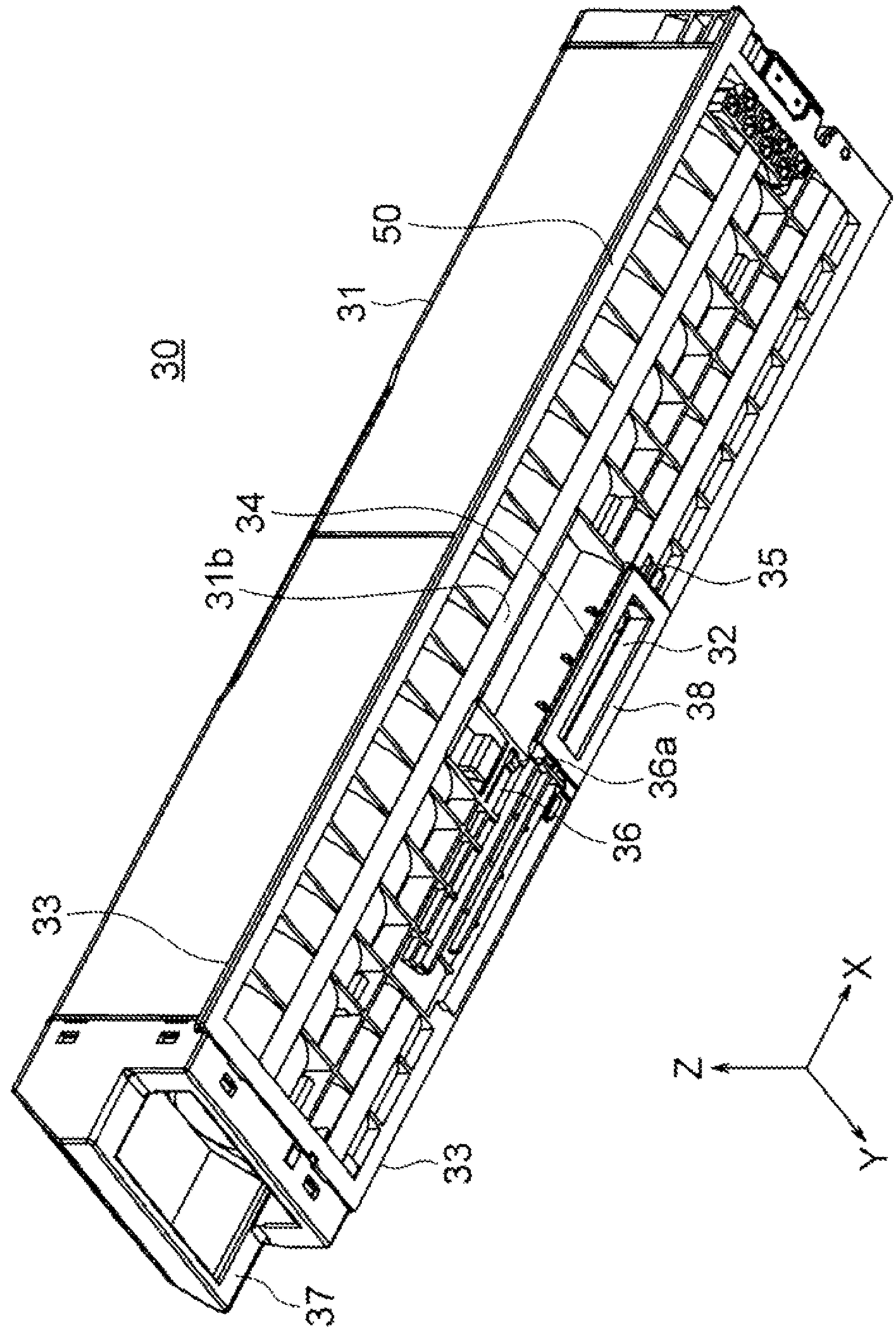

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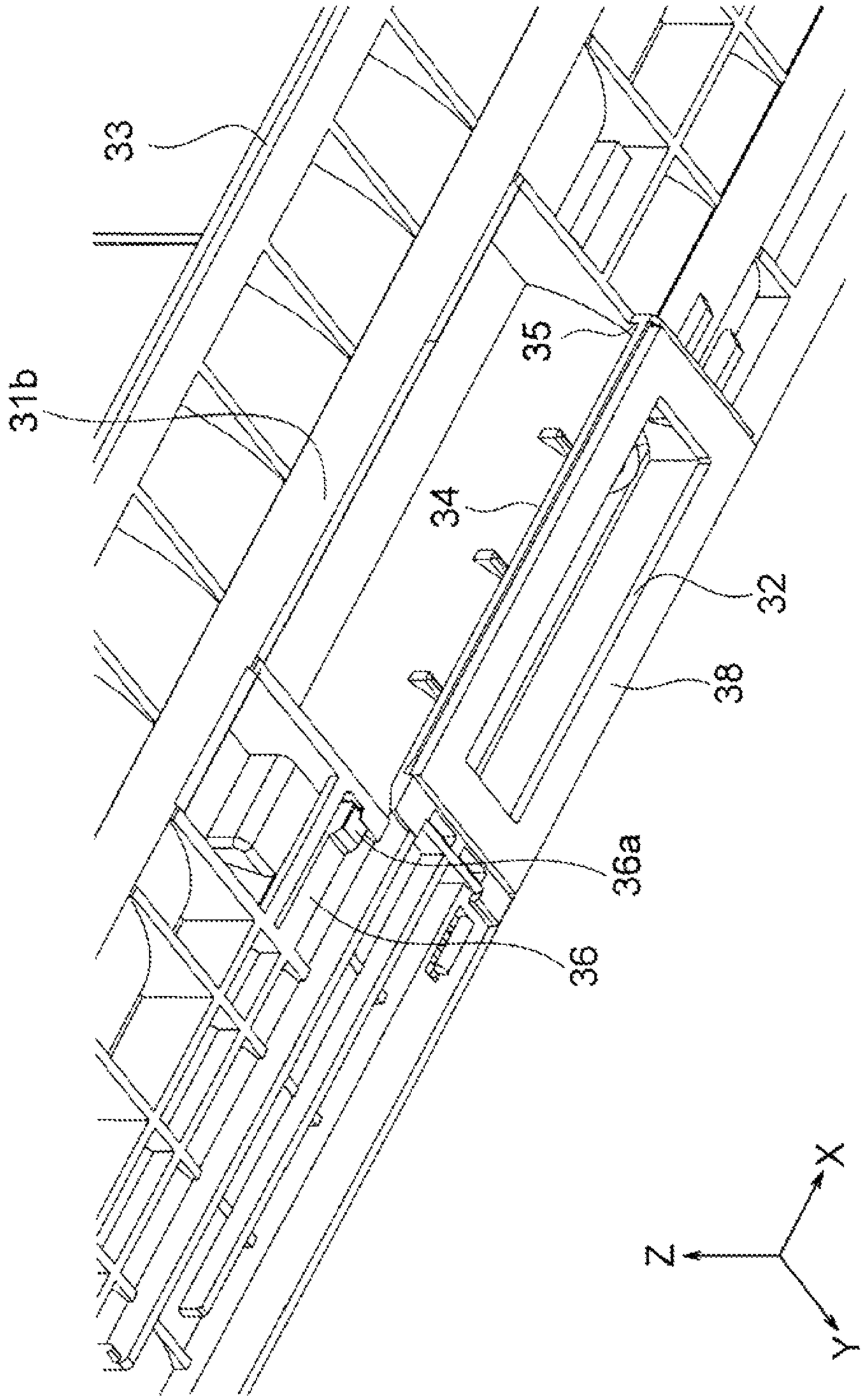
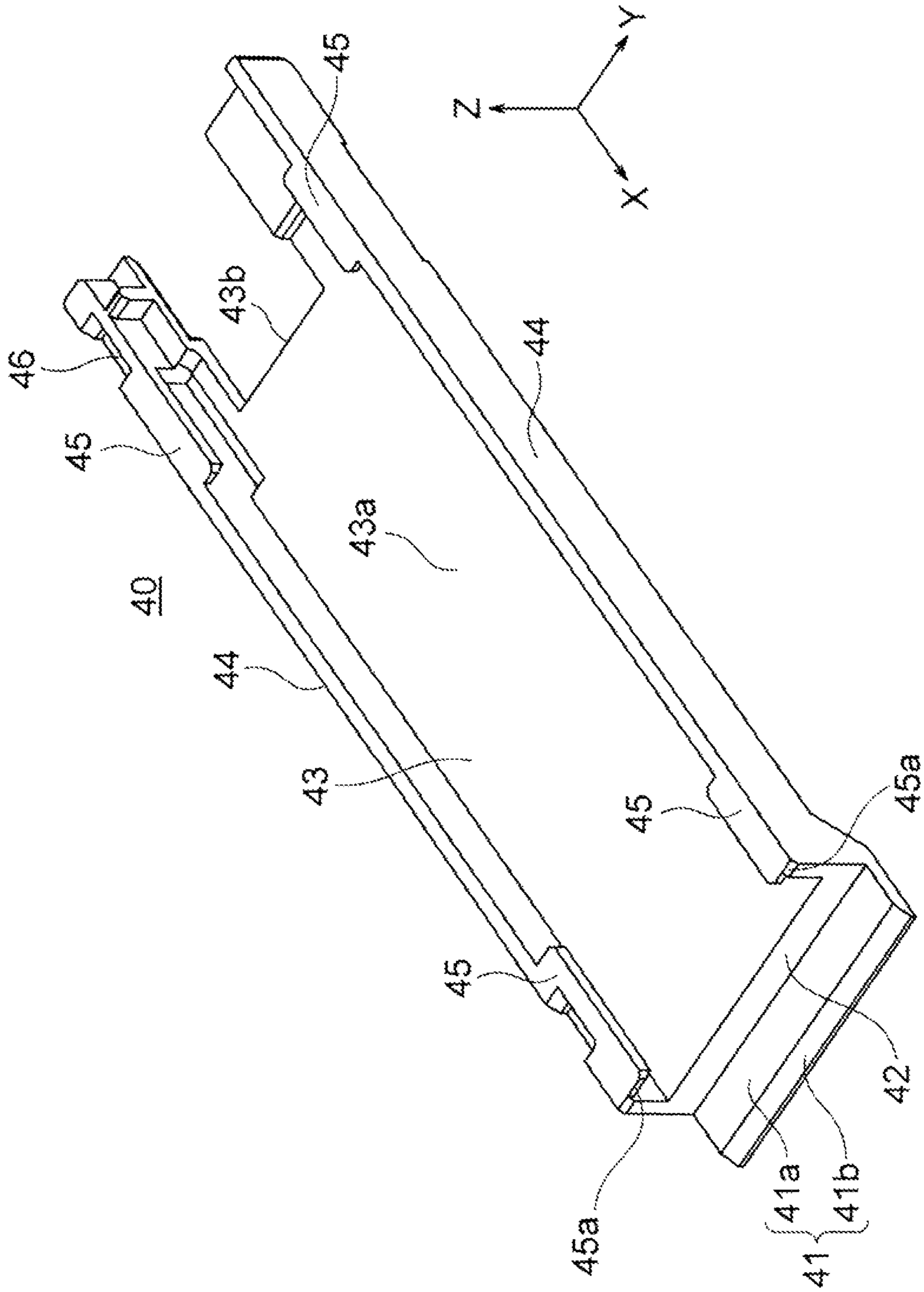


FIG. 8



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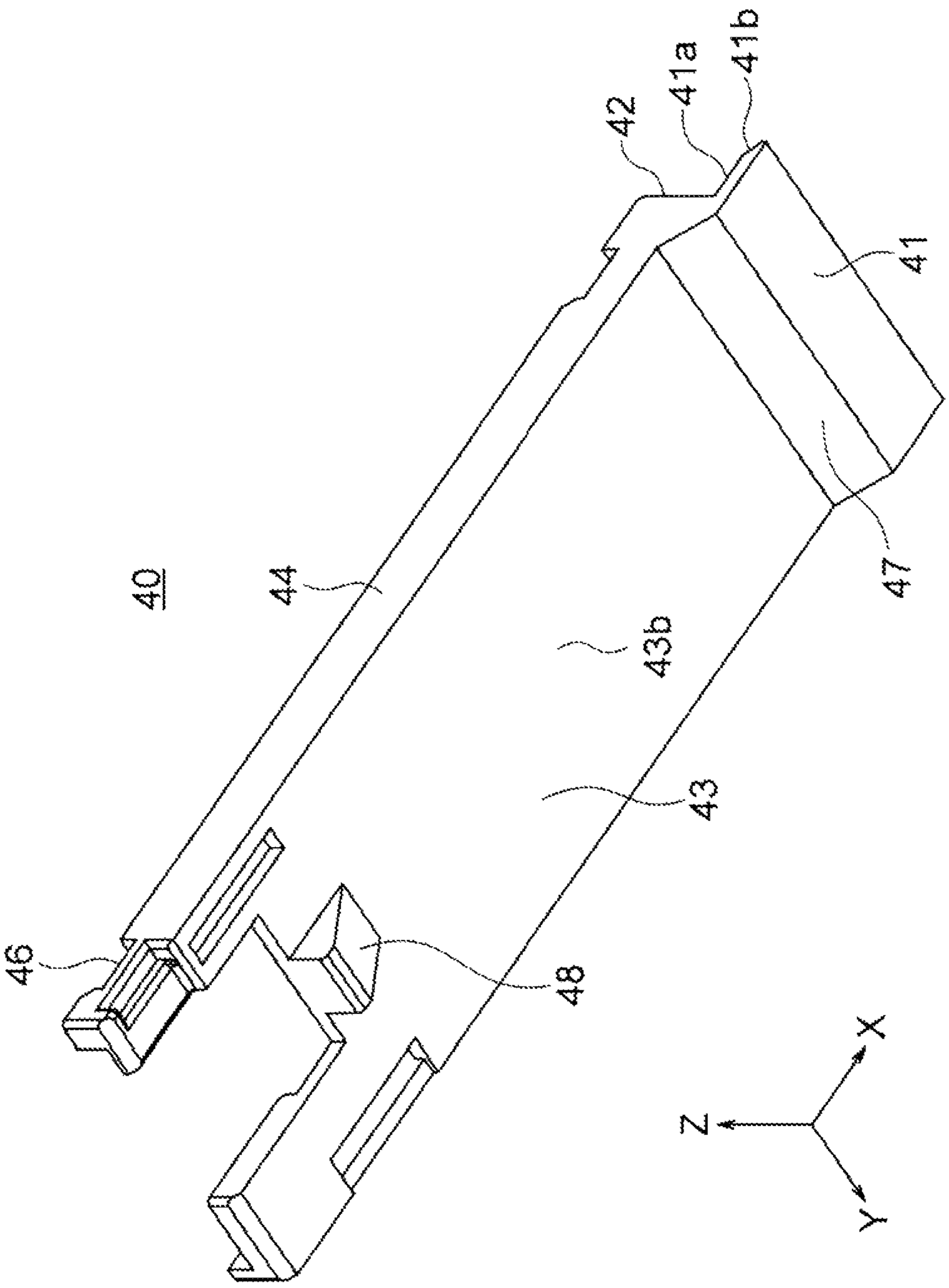

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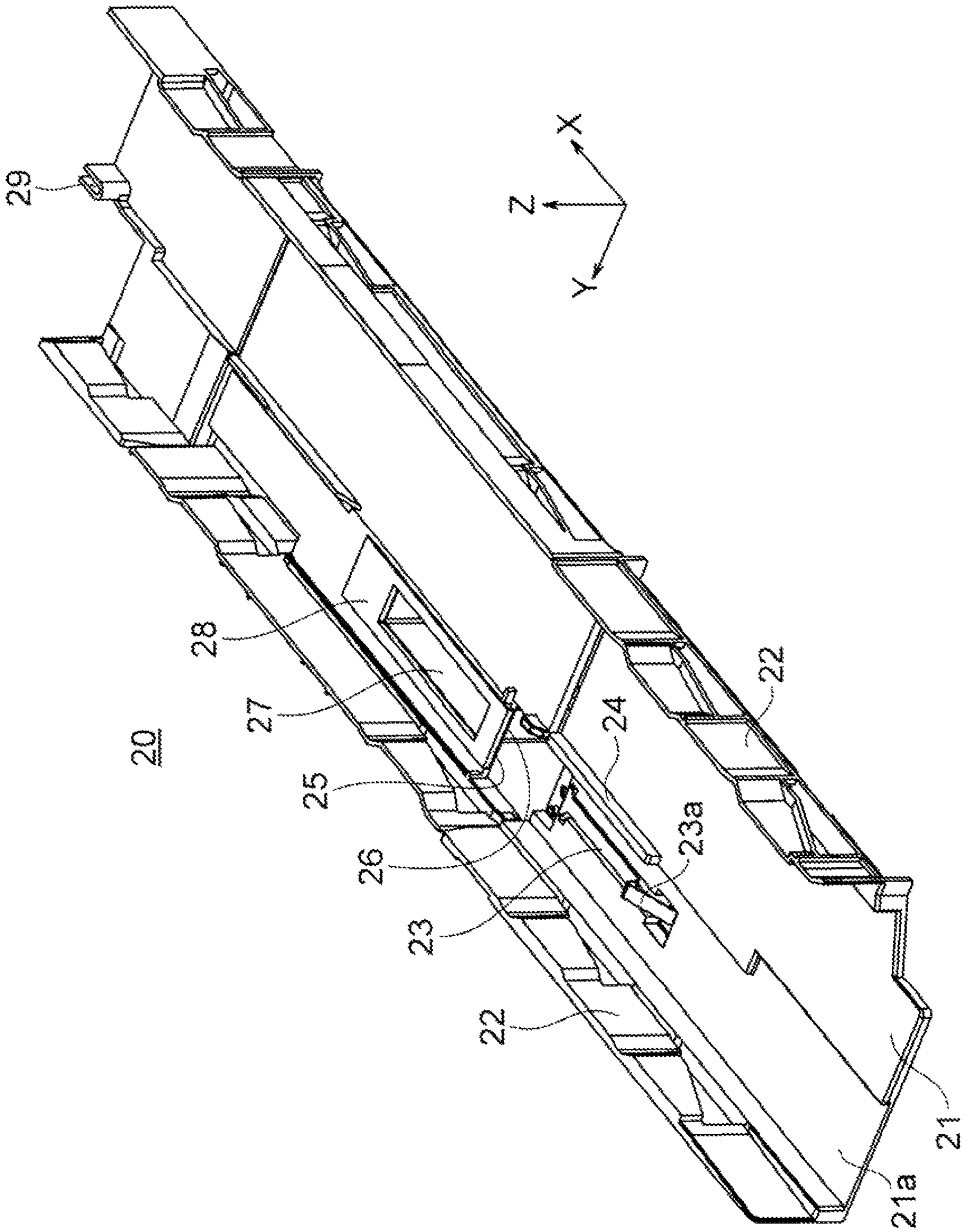

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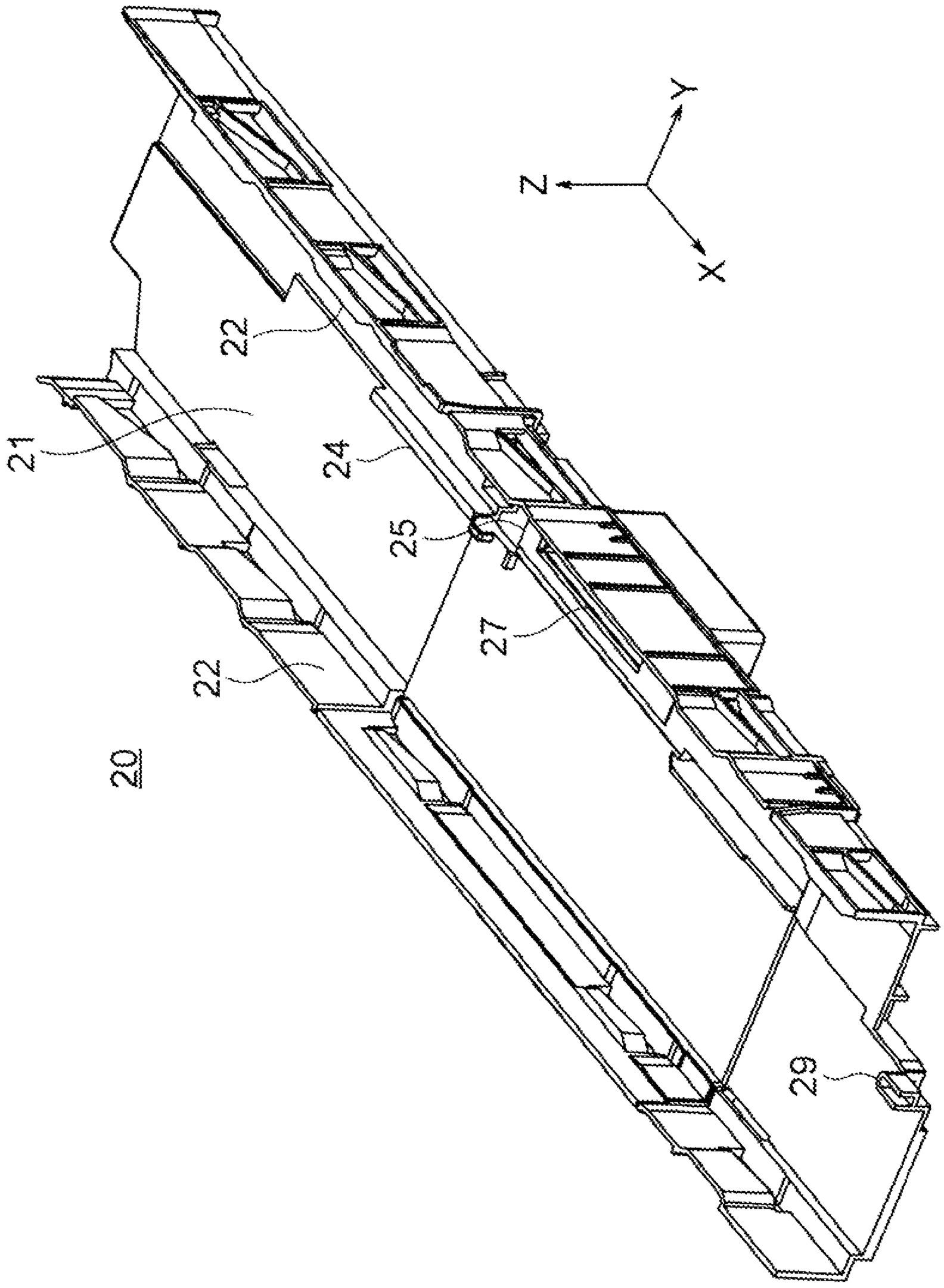


FIG. 12

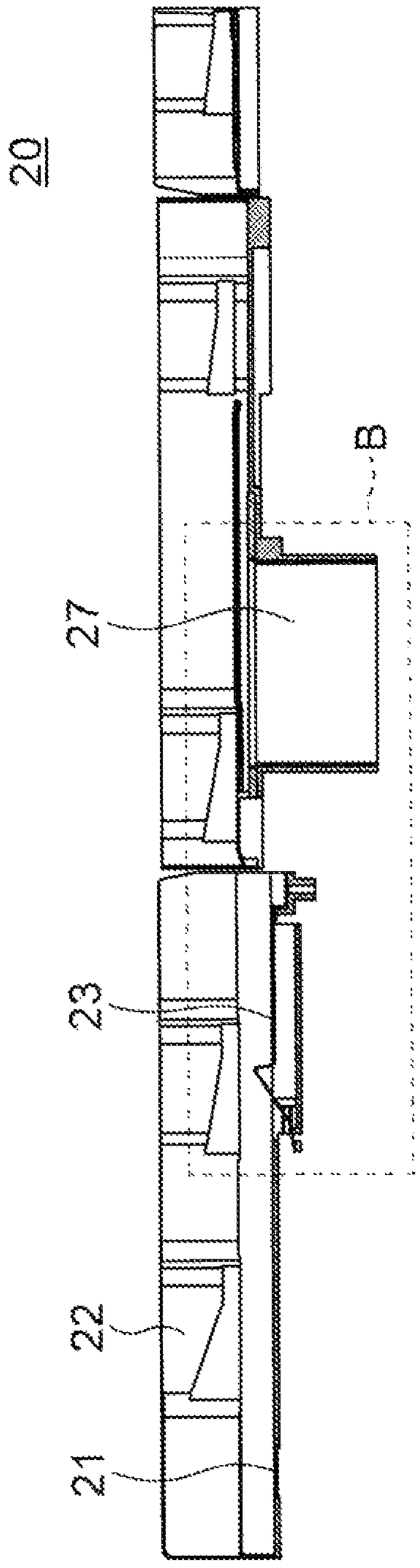


FIG. 13A

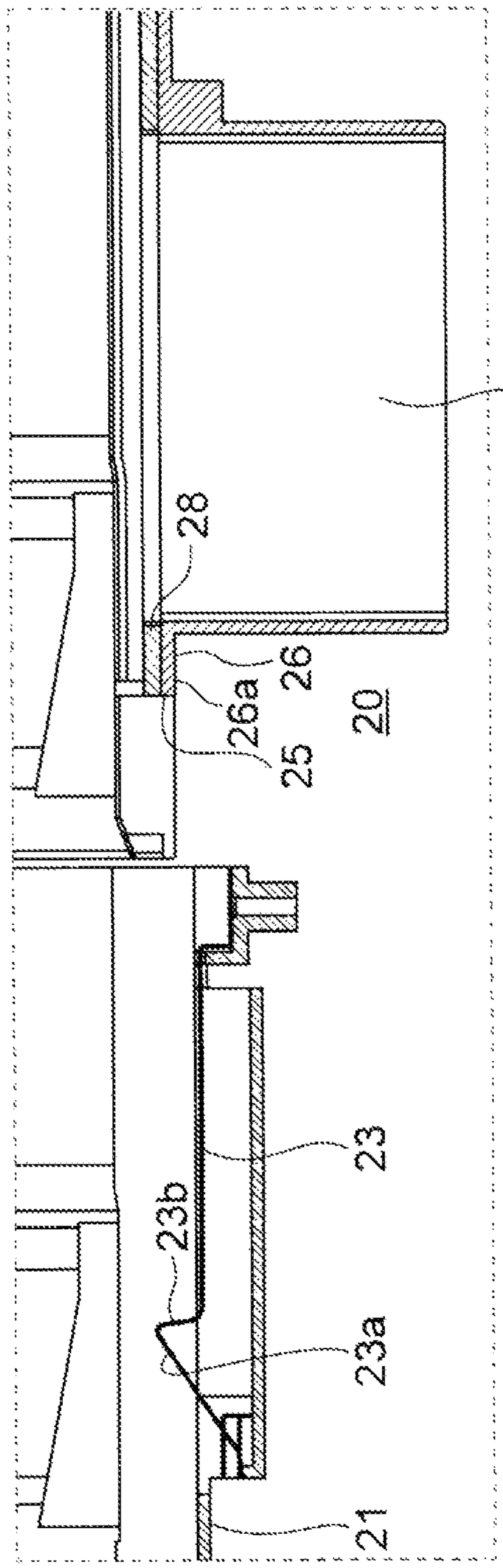
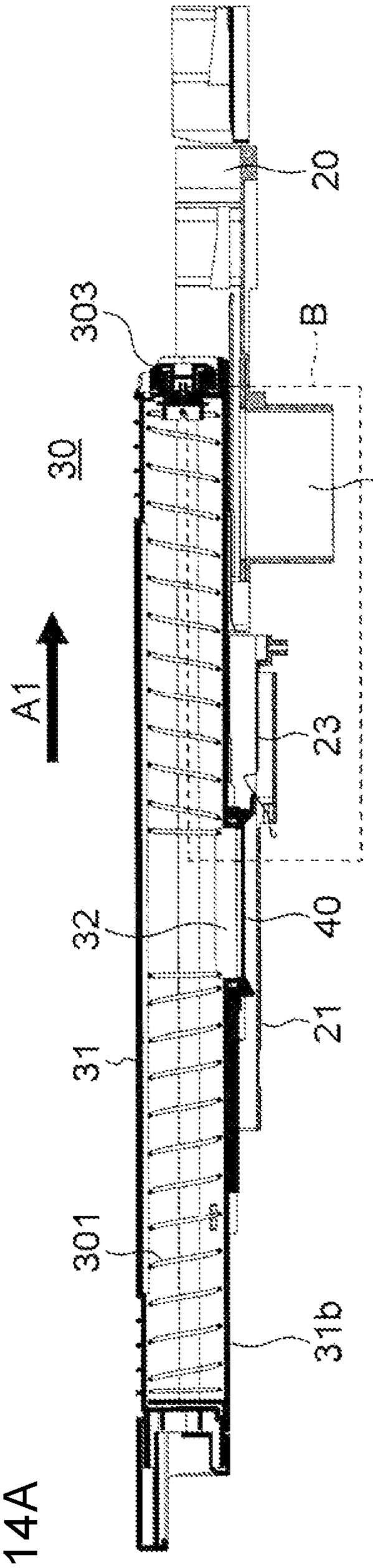


FIG. 13B



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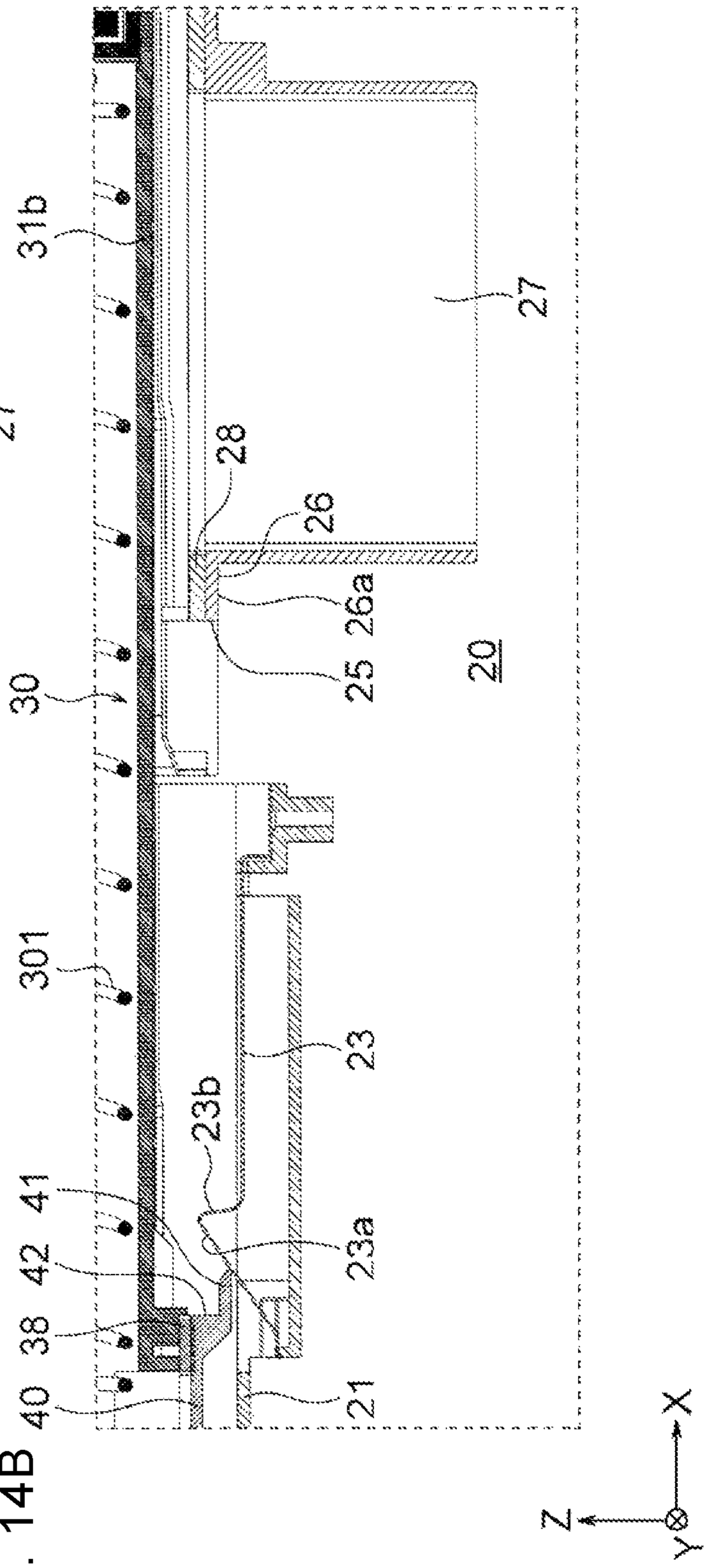


FIG. 14B

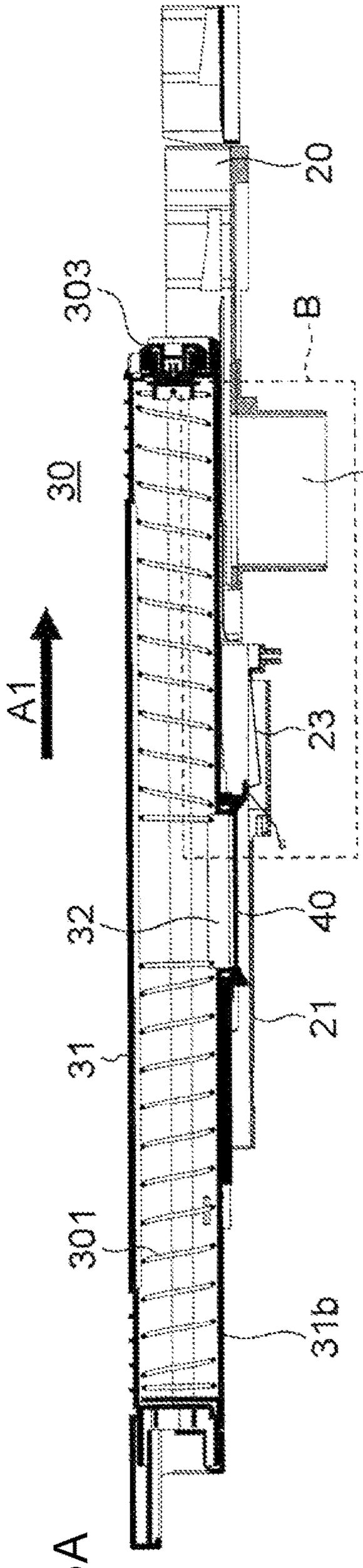
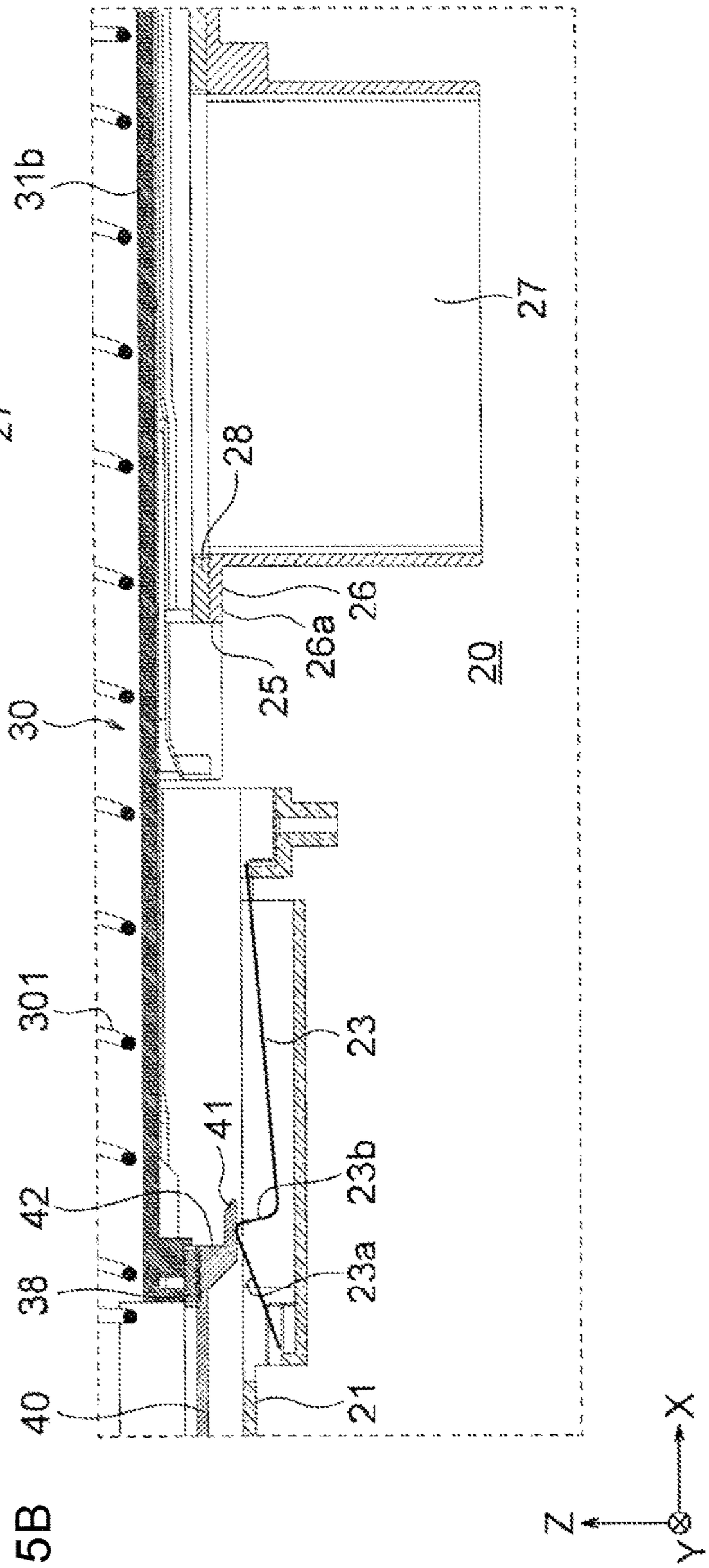


FIG. 15A



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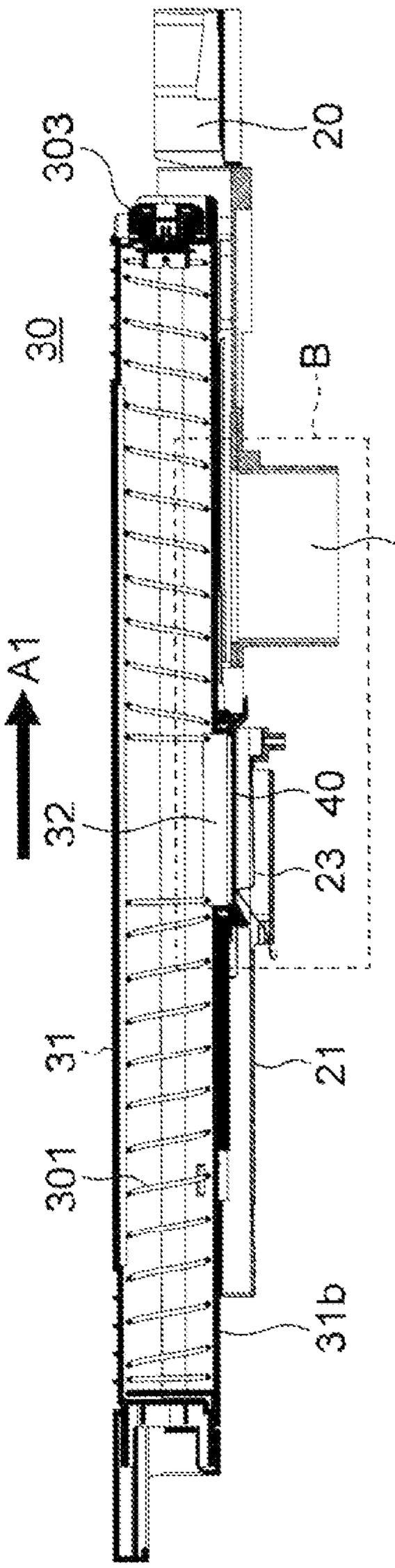
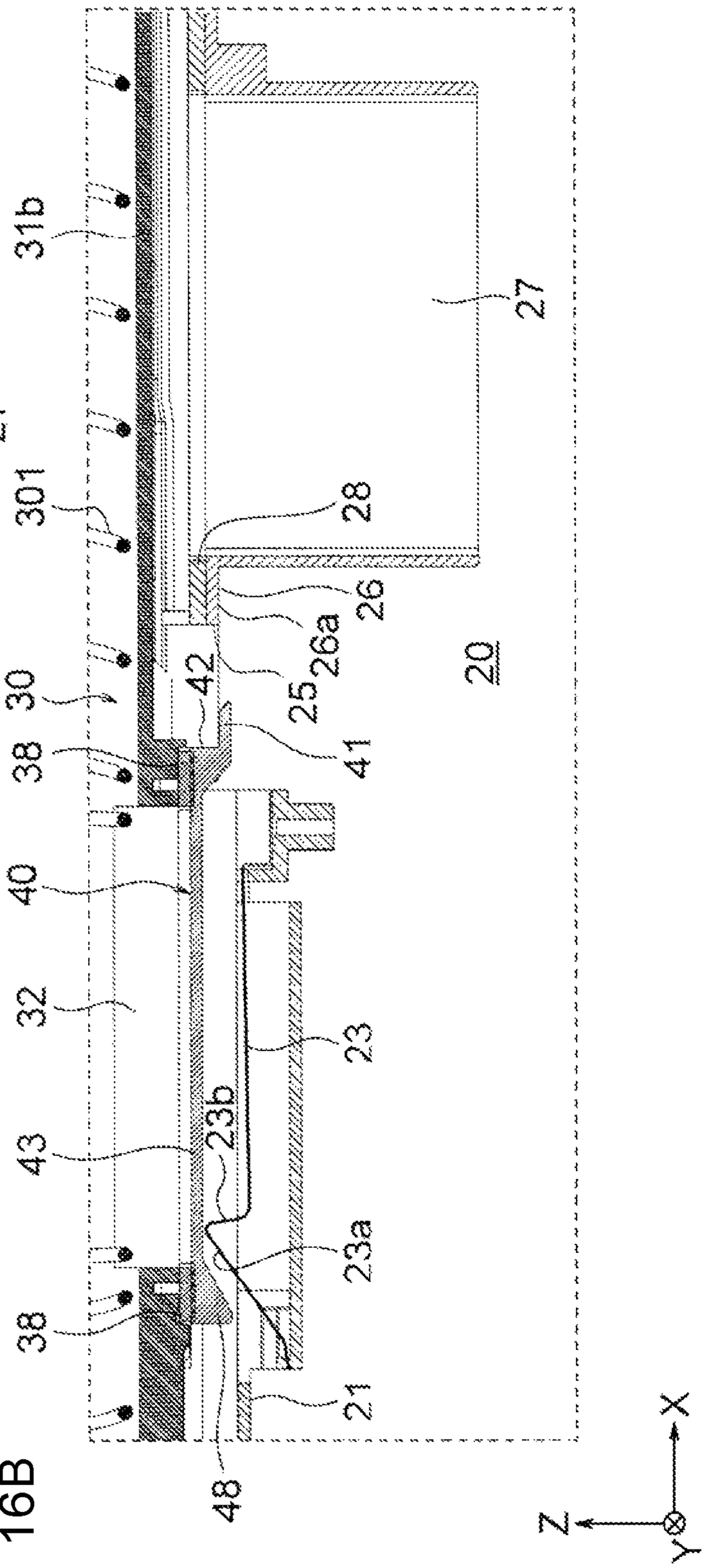


FIG. 16A



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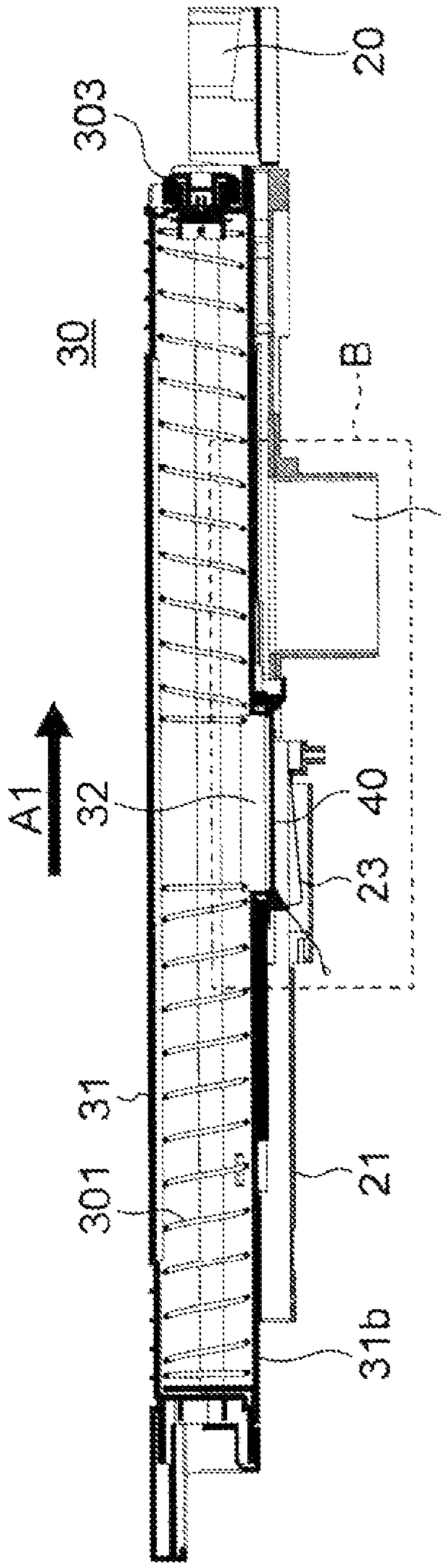

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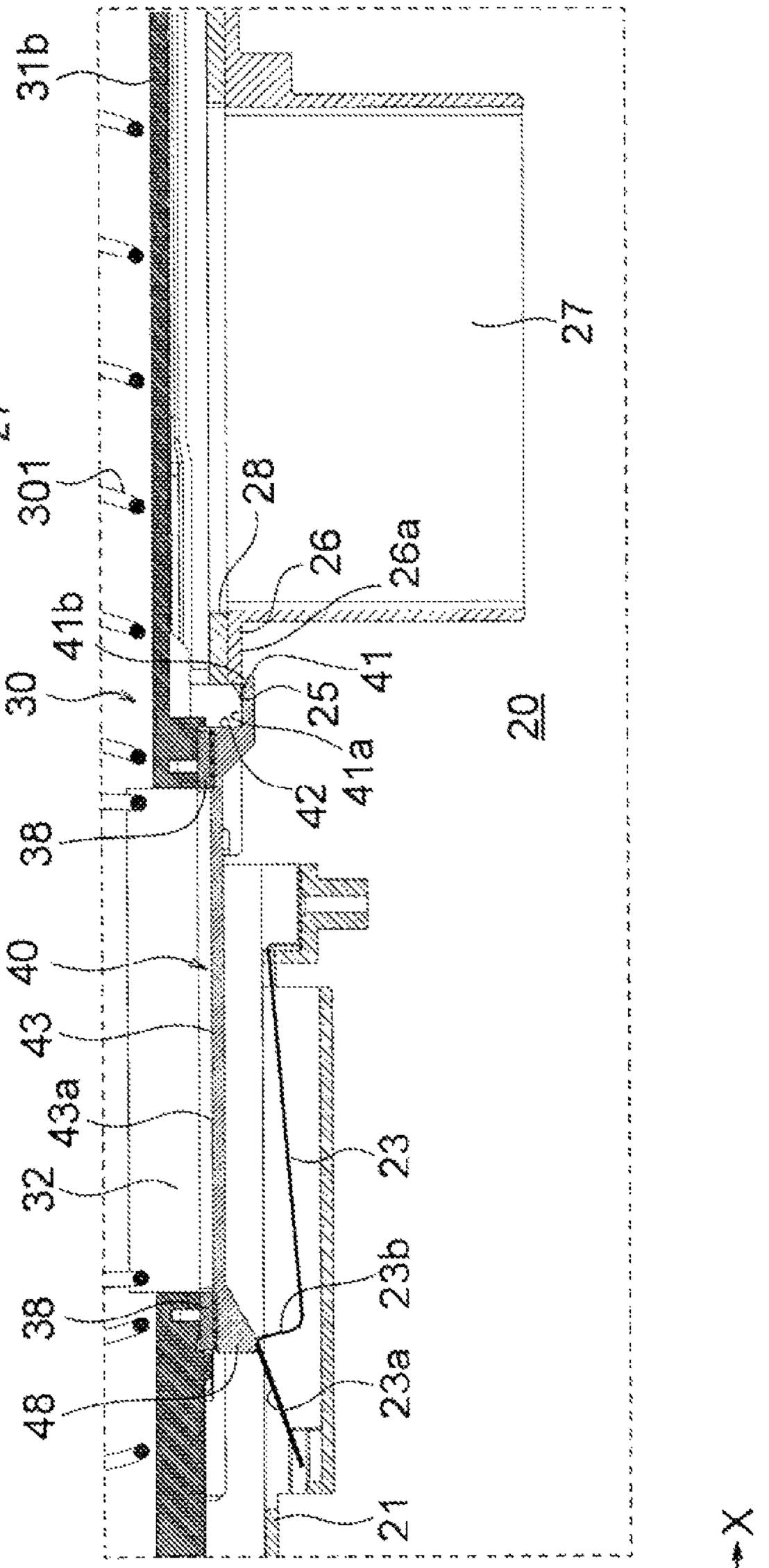


FIG. 17B

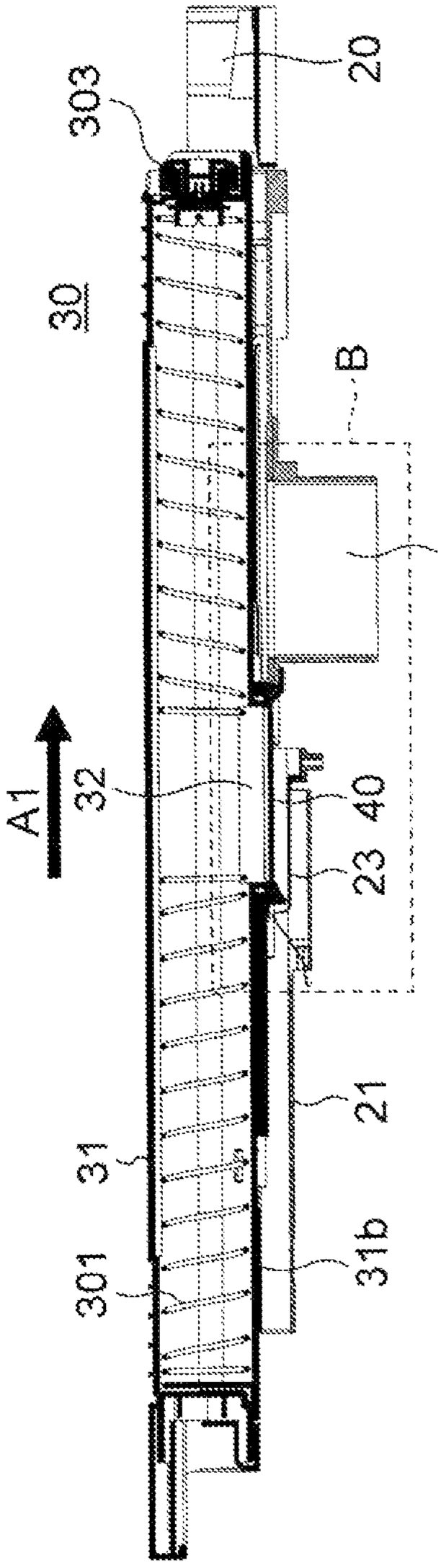


FIG. 18A

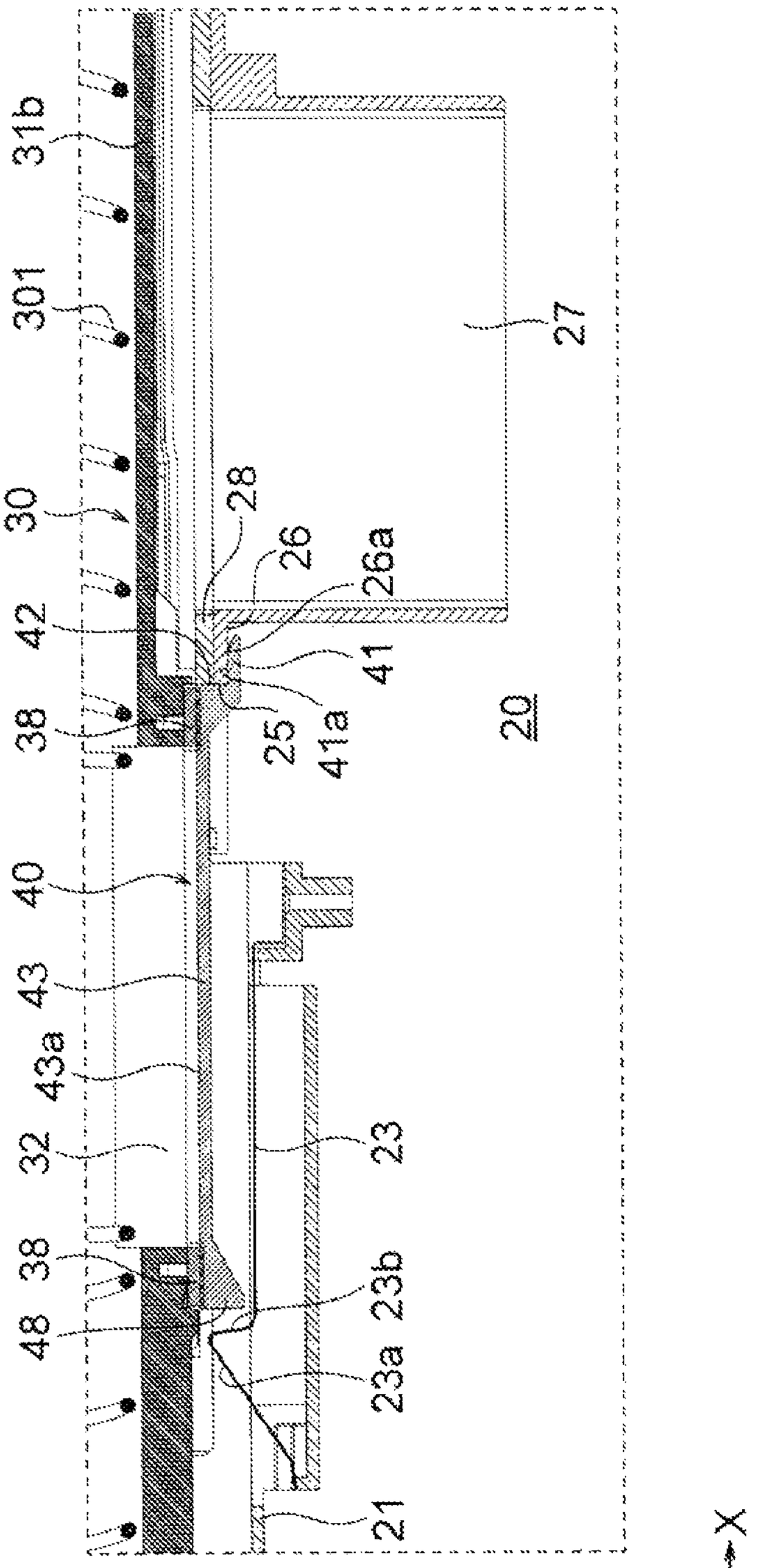


FIG. 18B

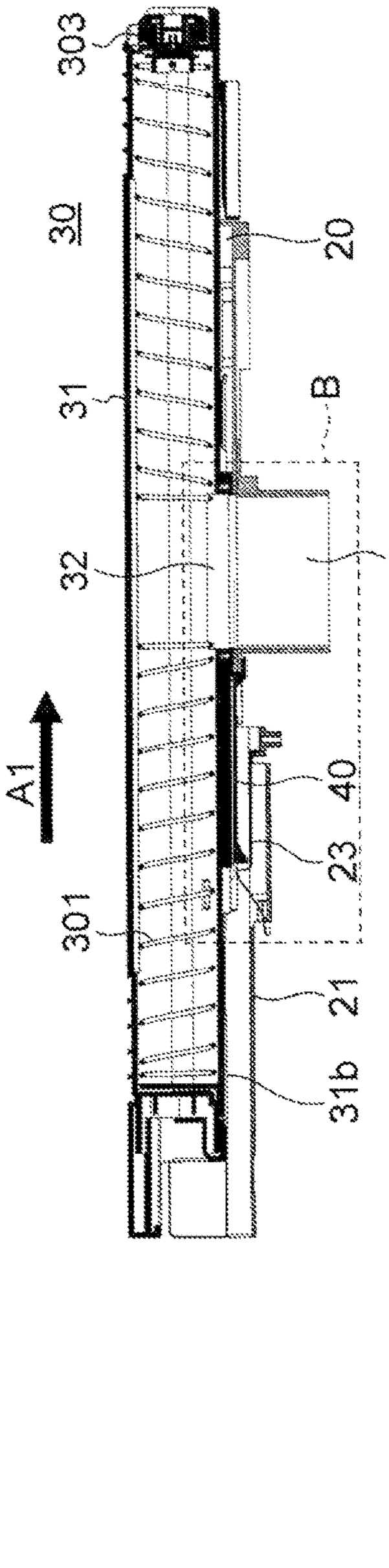


FIG. 19A

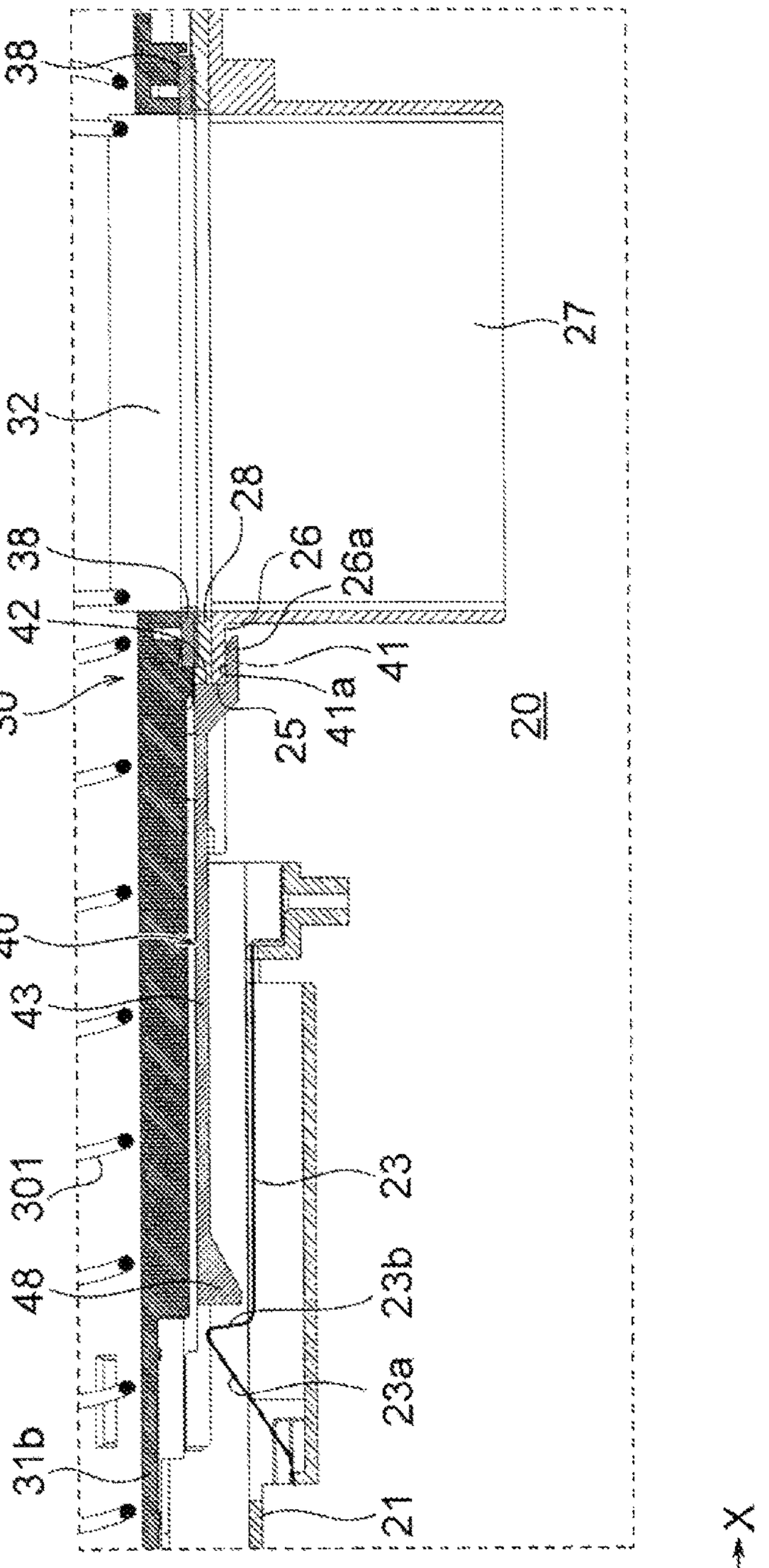


FIG. 19B

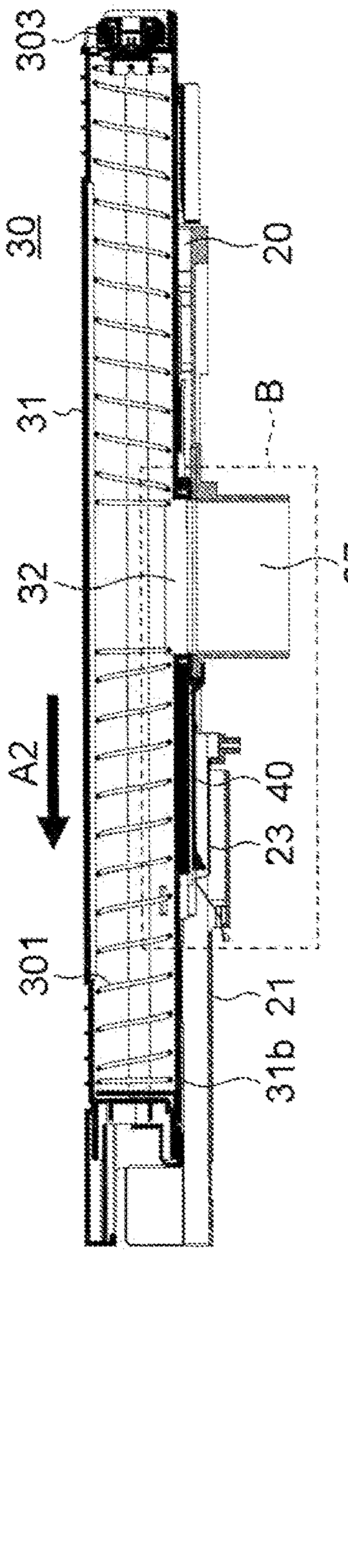


FIG. 20A

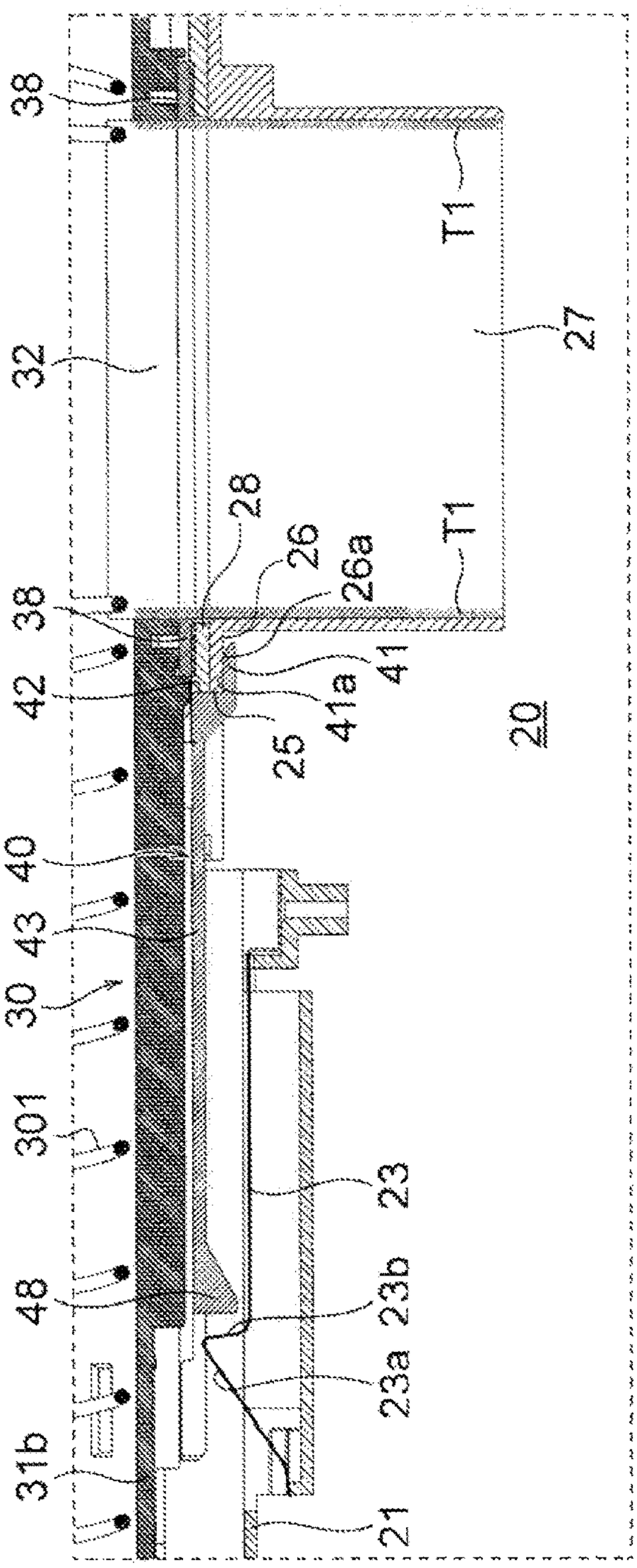


FIG. 20B

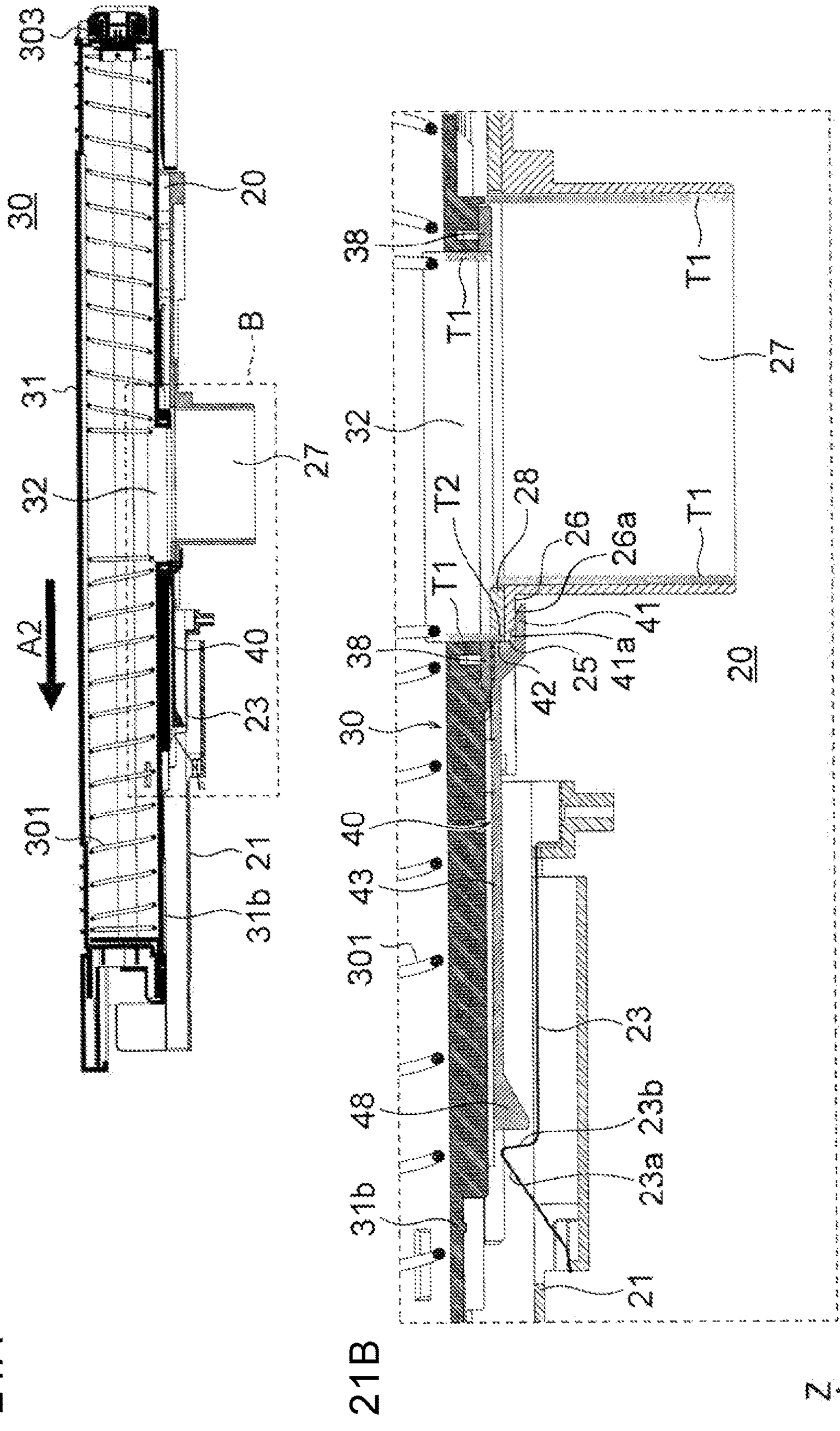


FIG. 21A

FIG. 21B

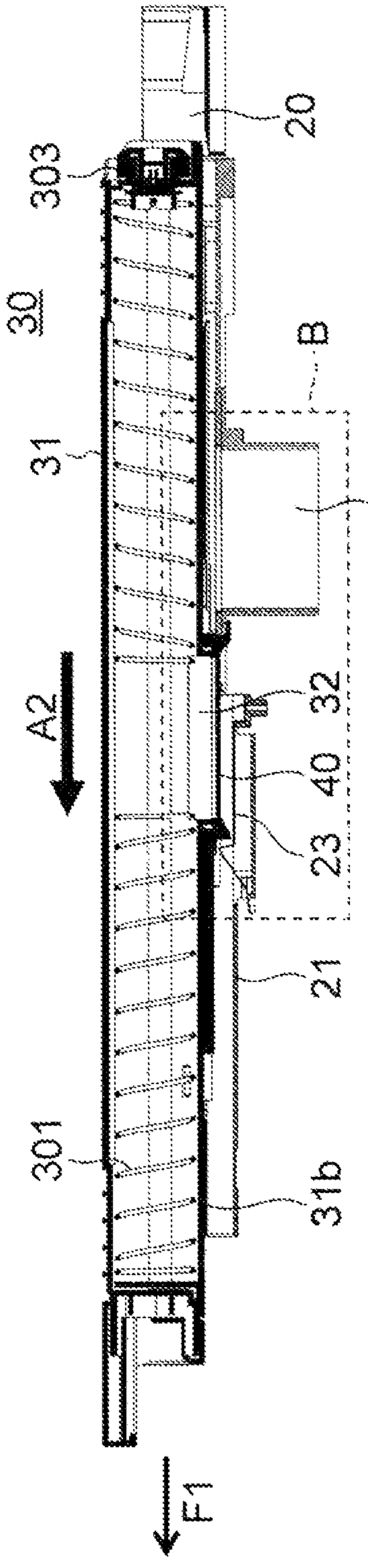
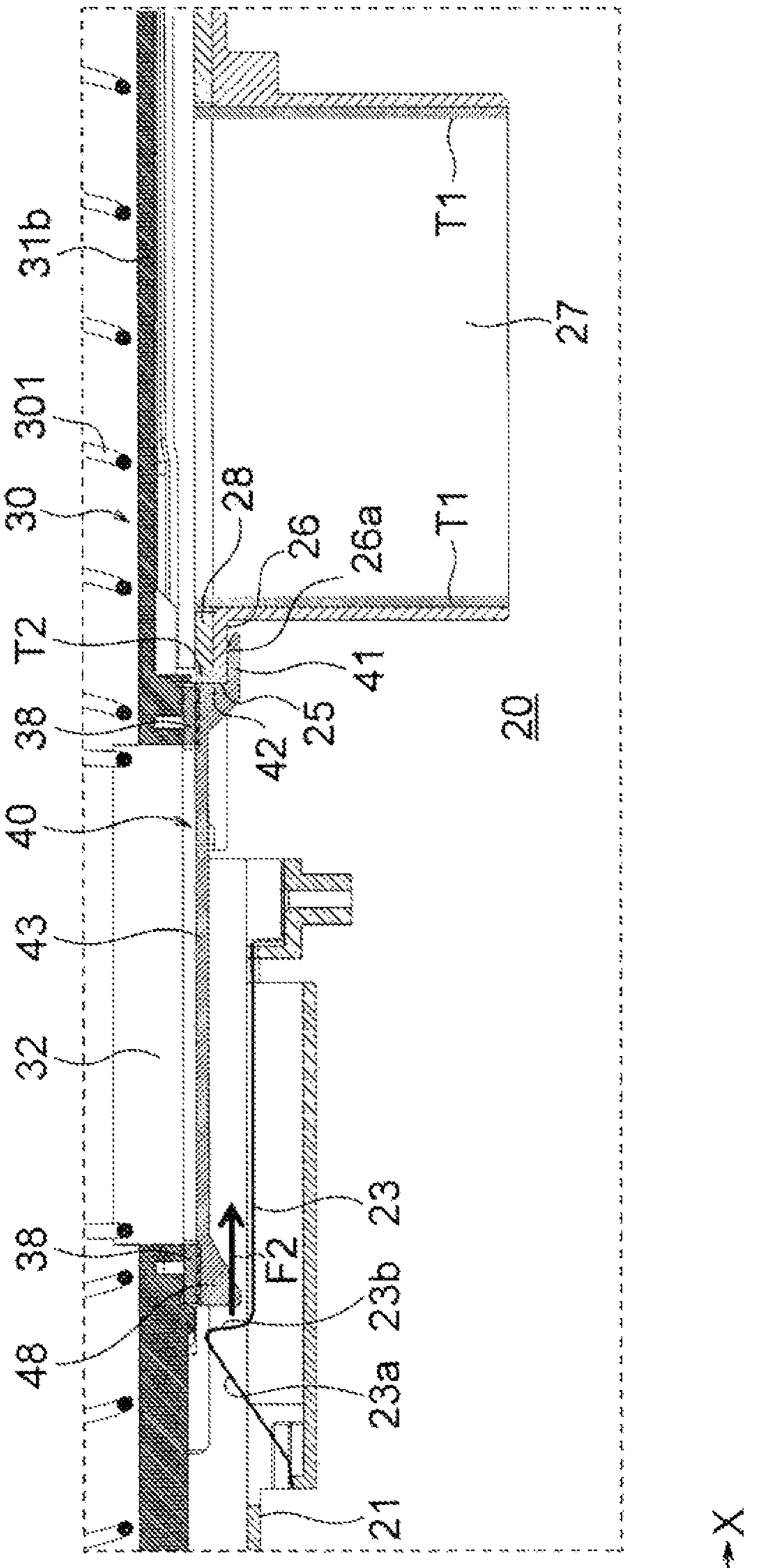


FIG. 22A



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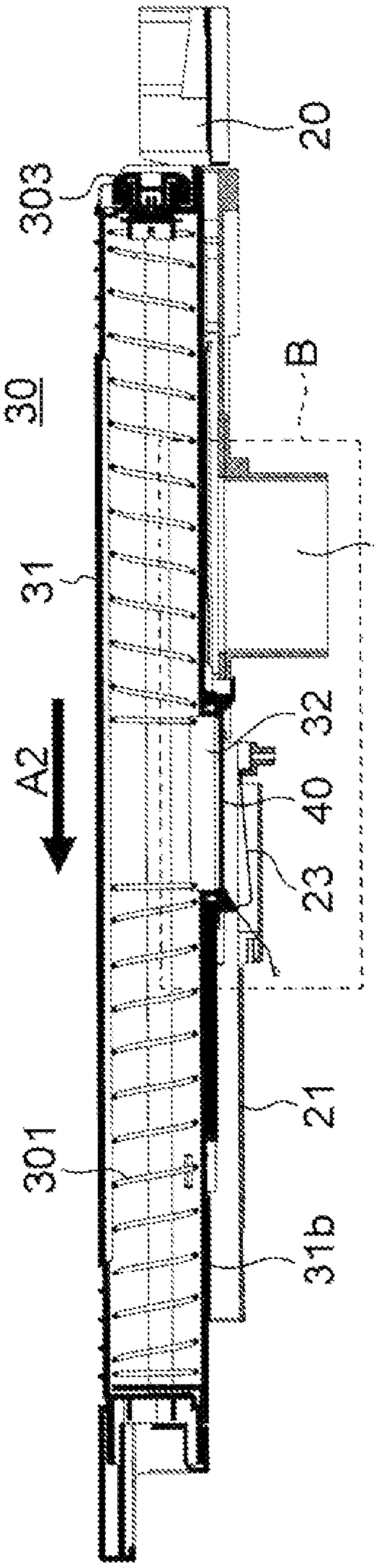

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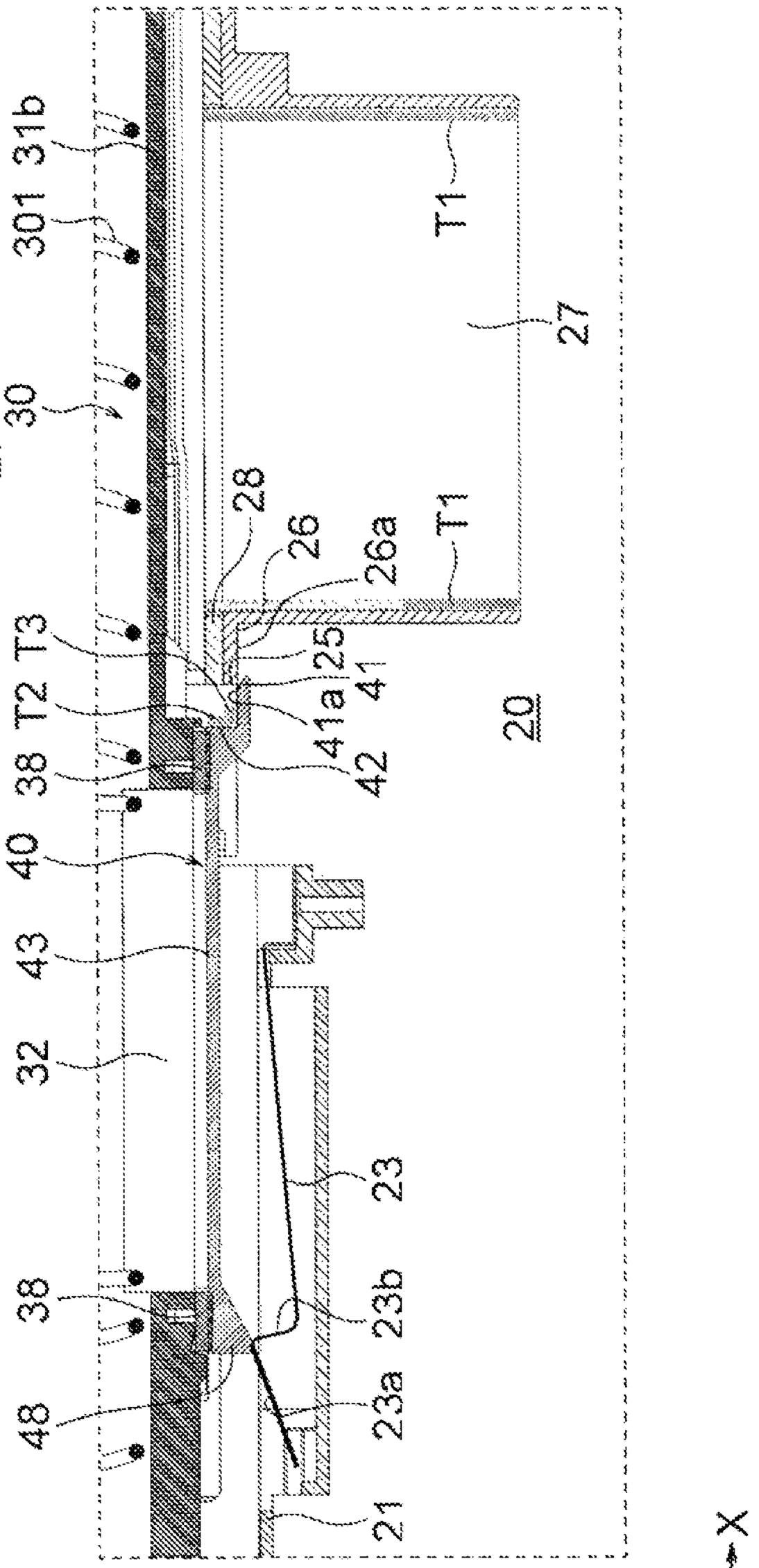

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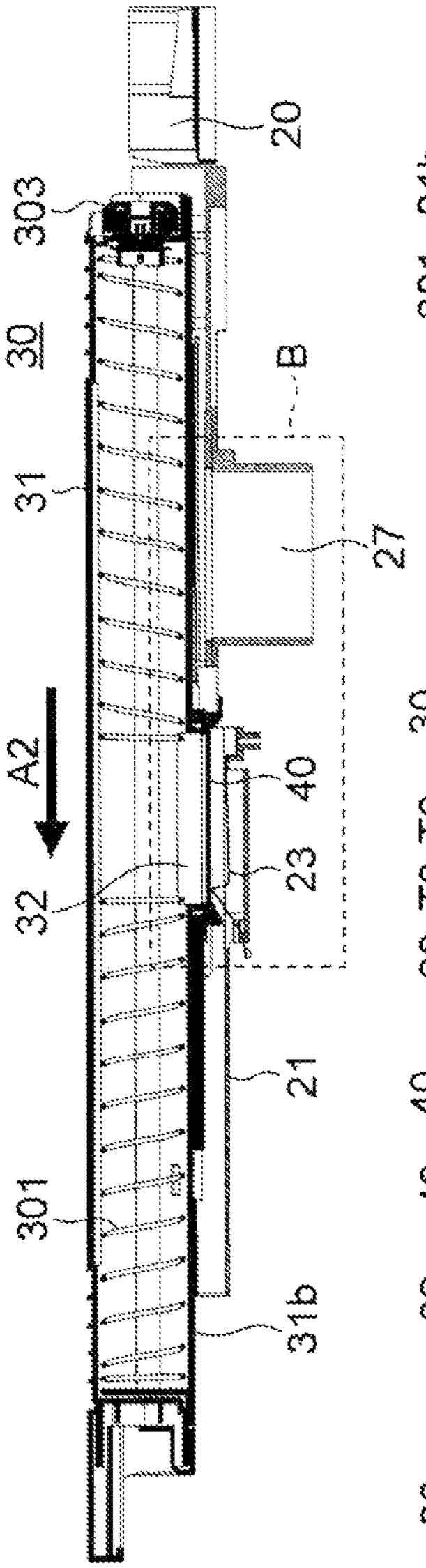

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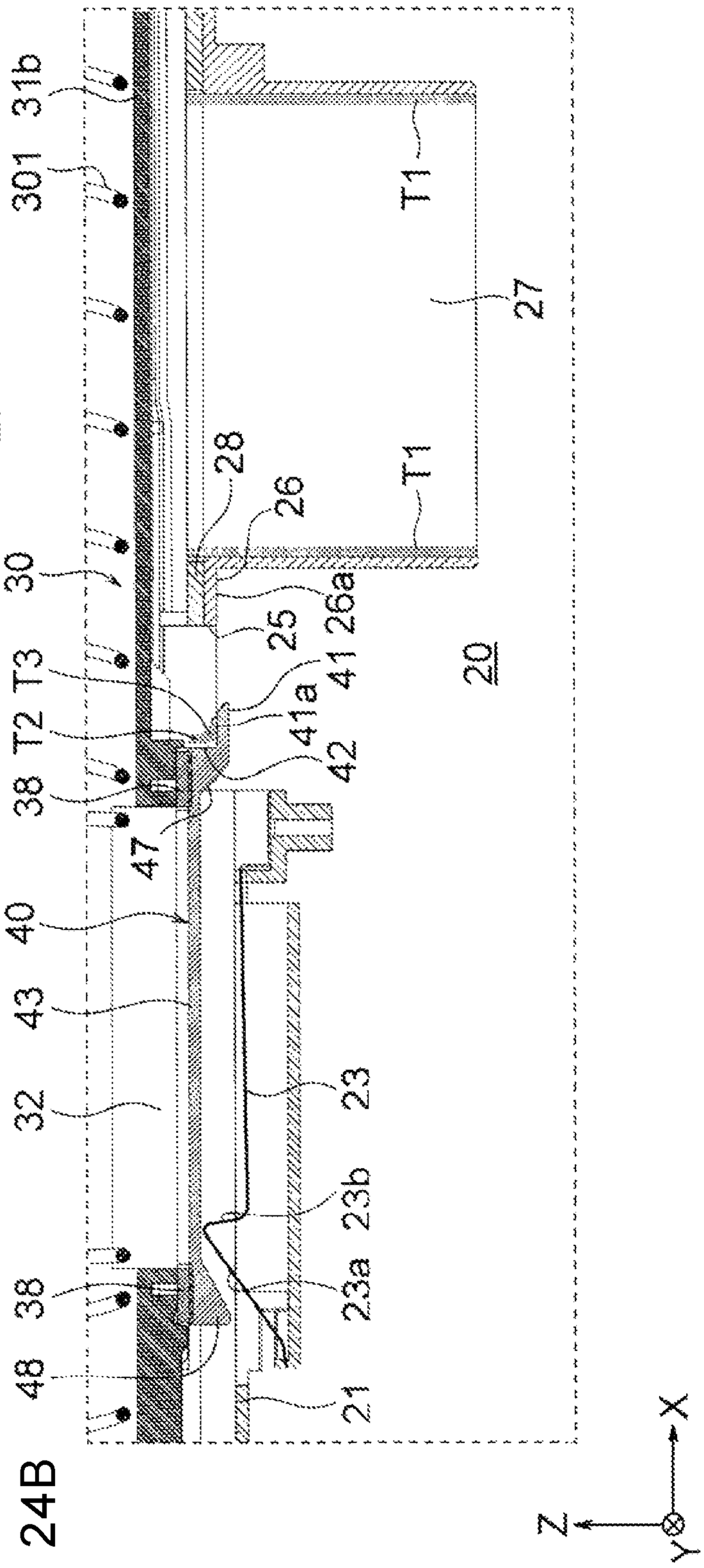

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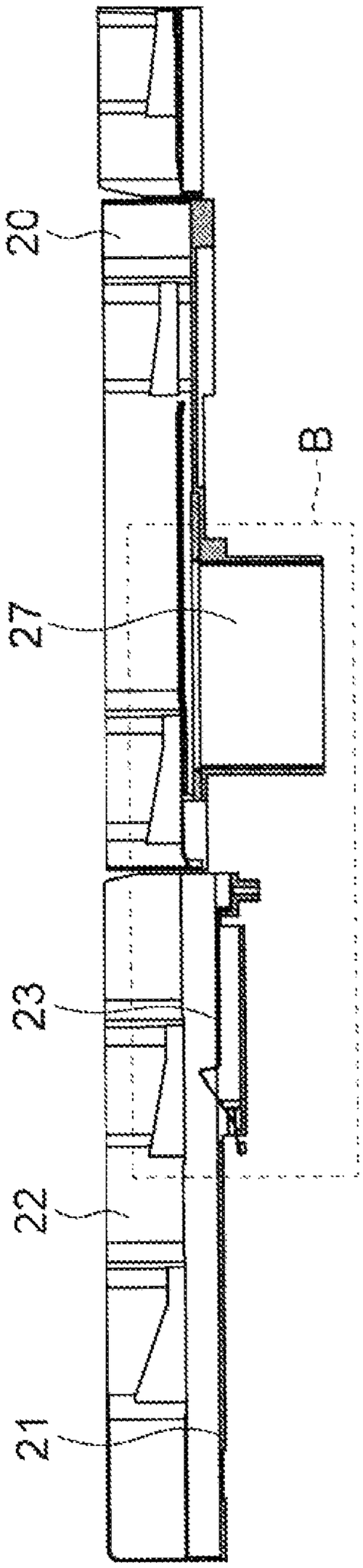

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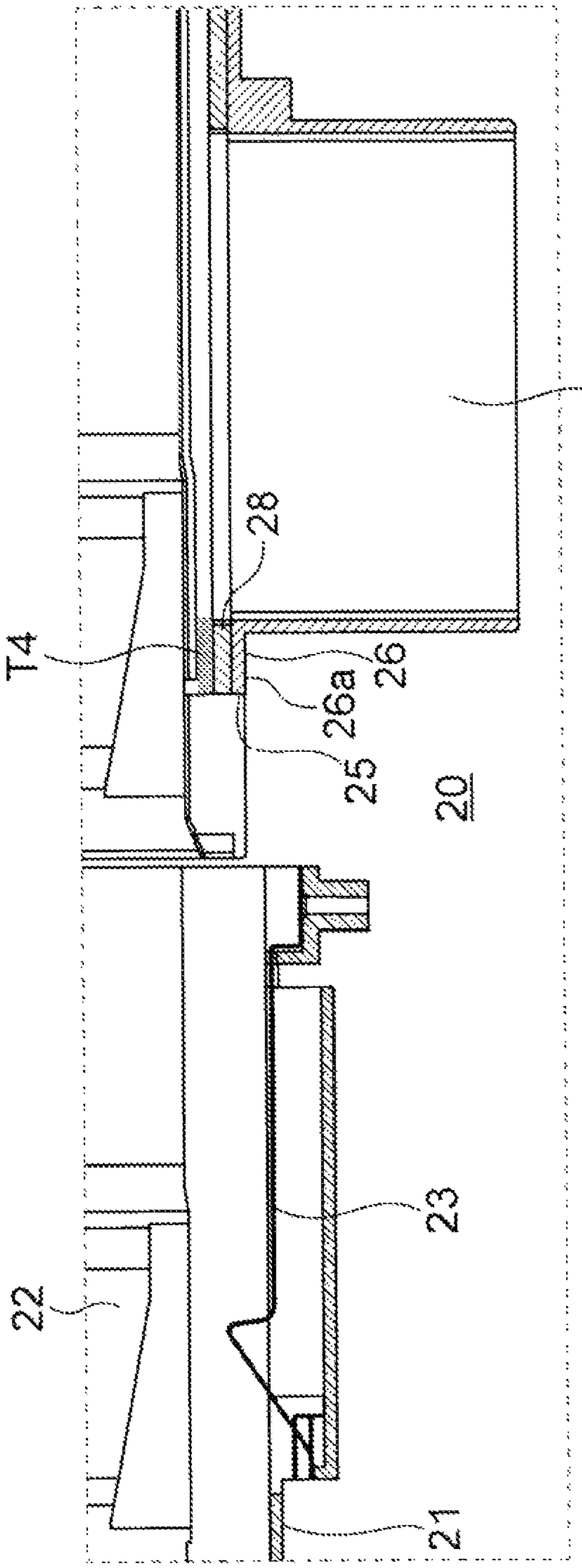

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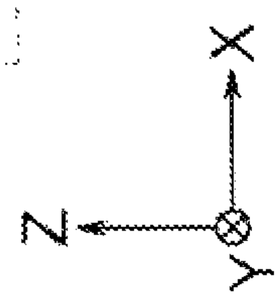

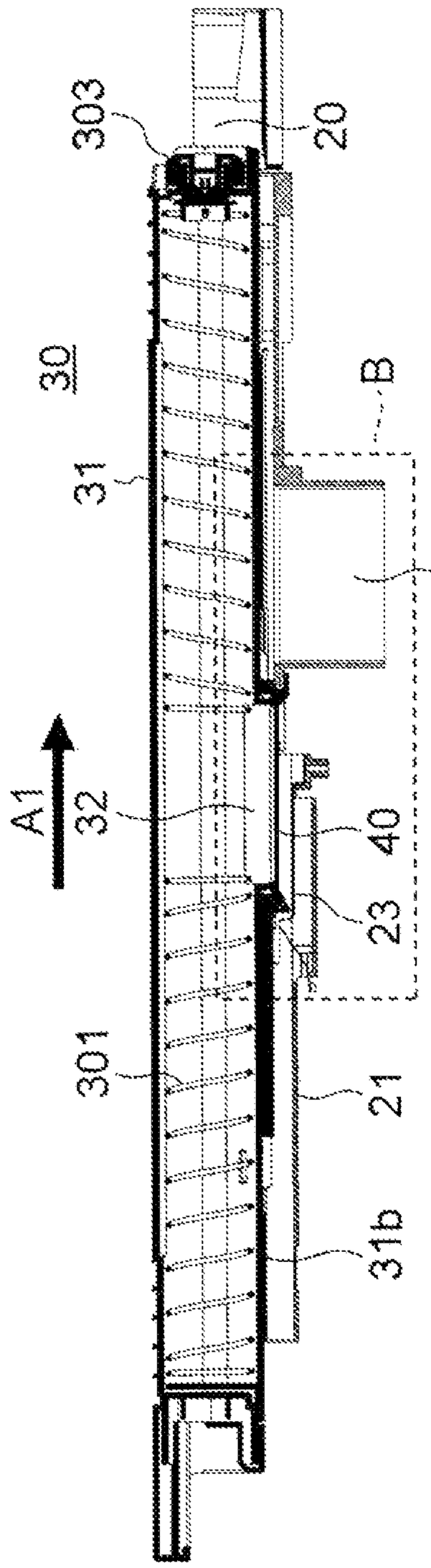

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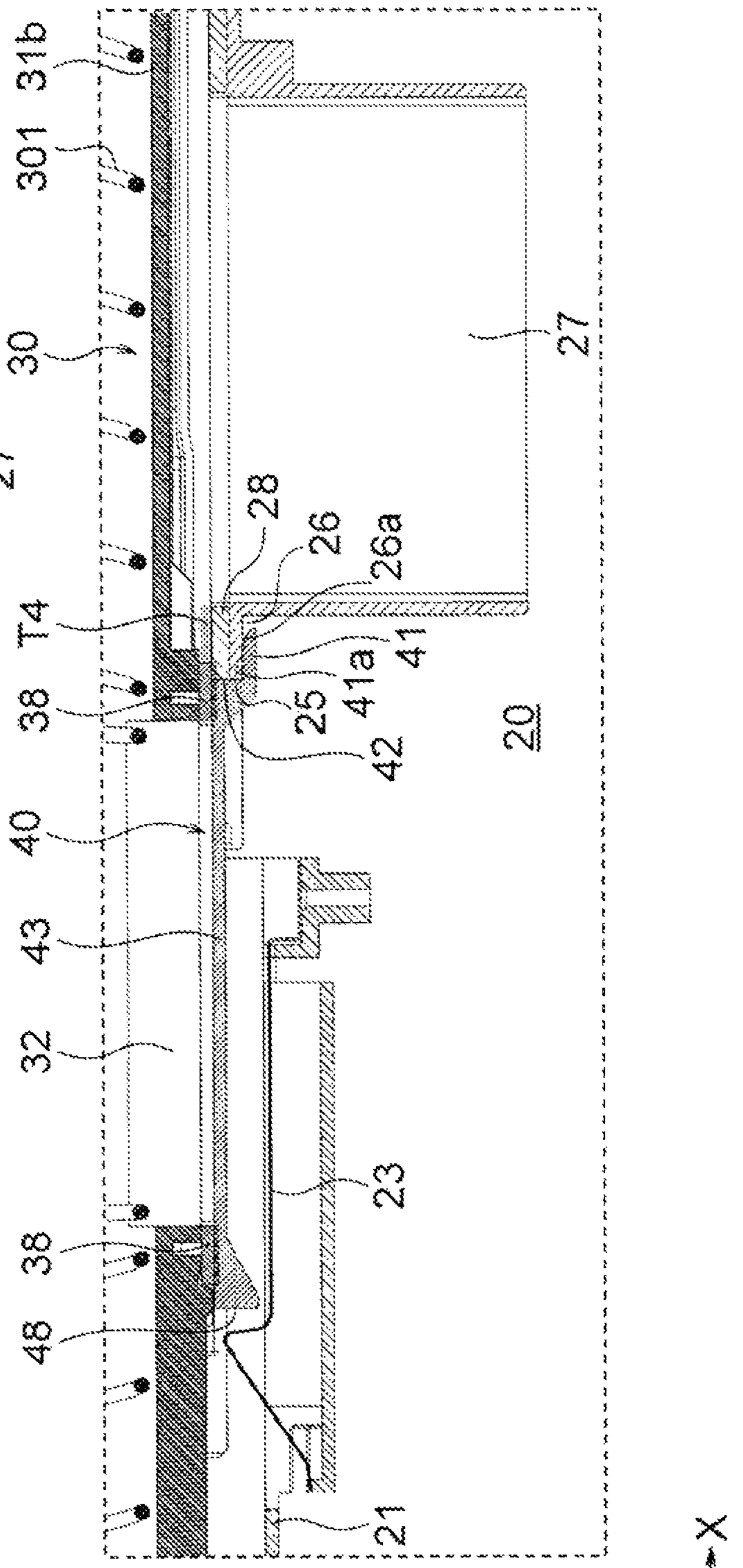

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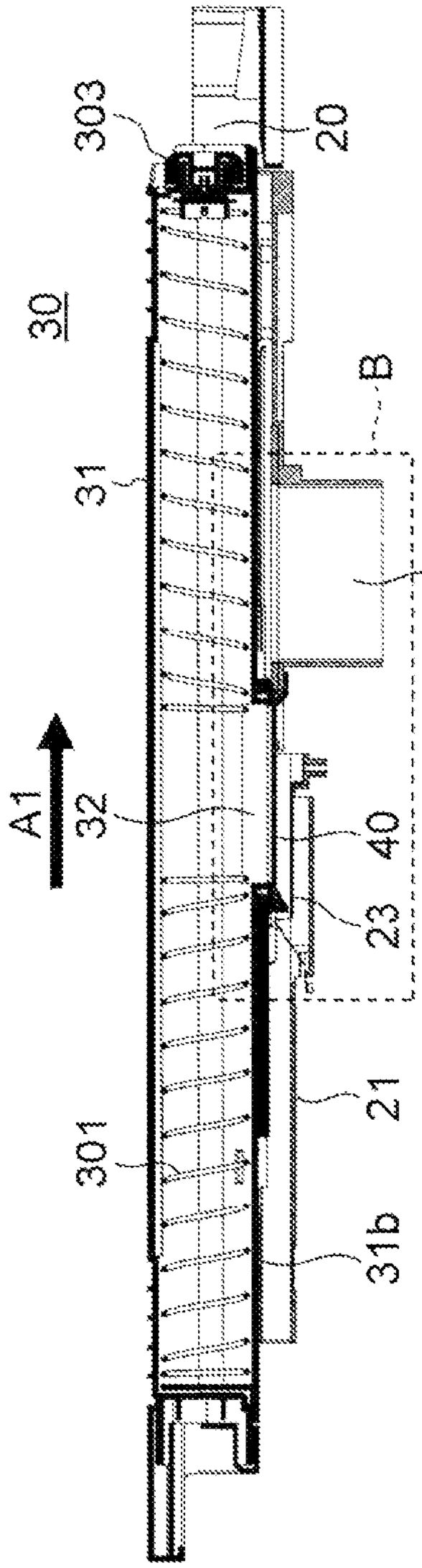


FIG. 27A

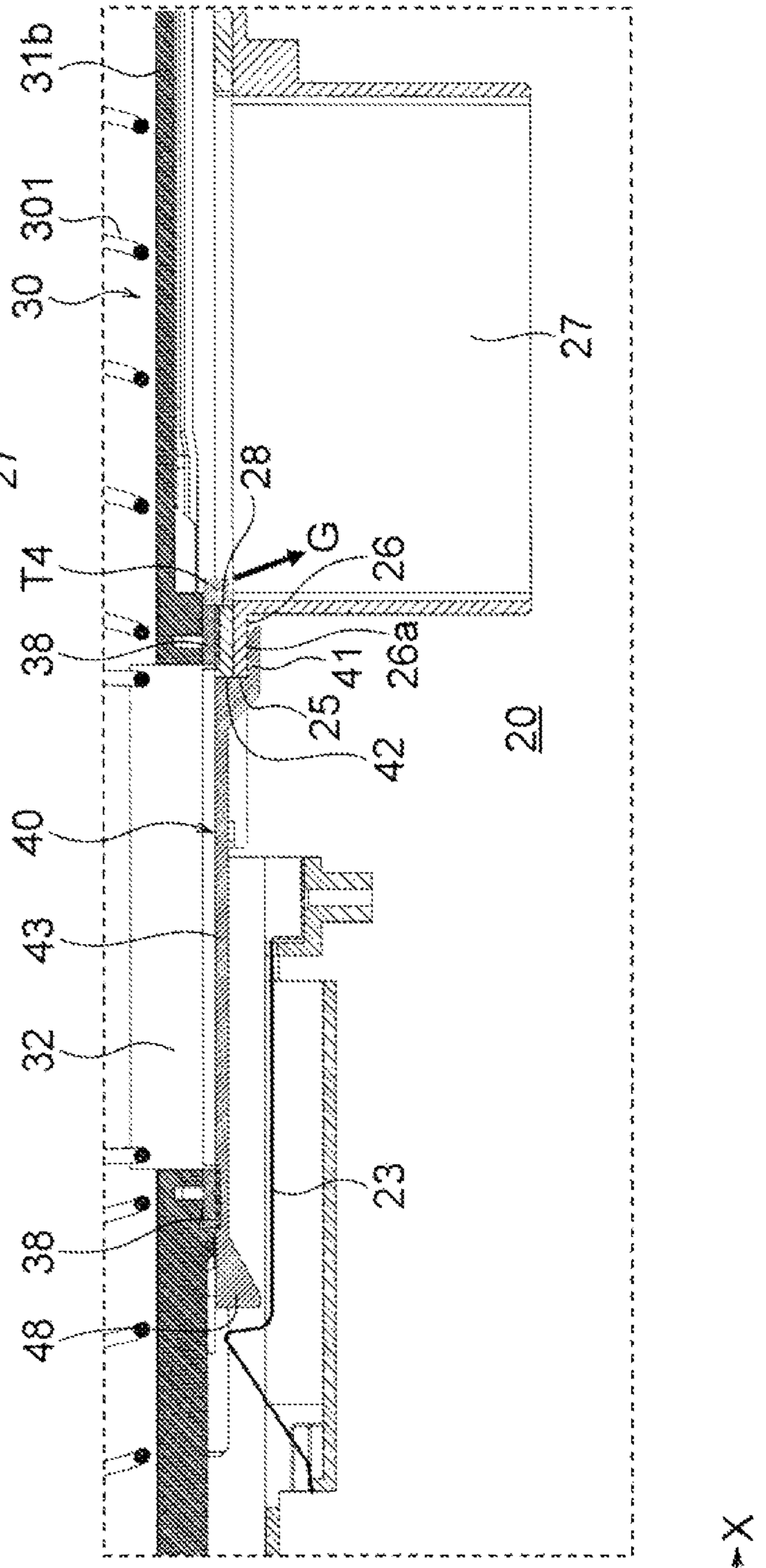


FIG. 27B

FIG. 28A

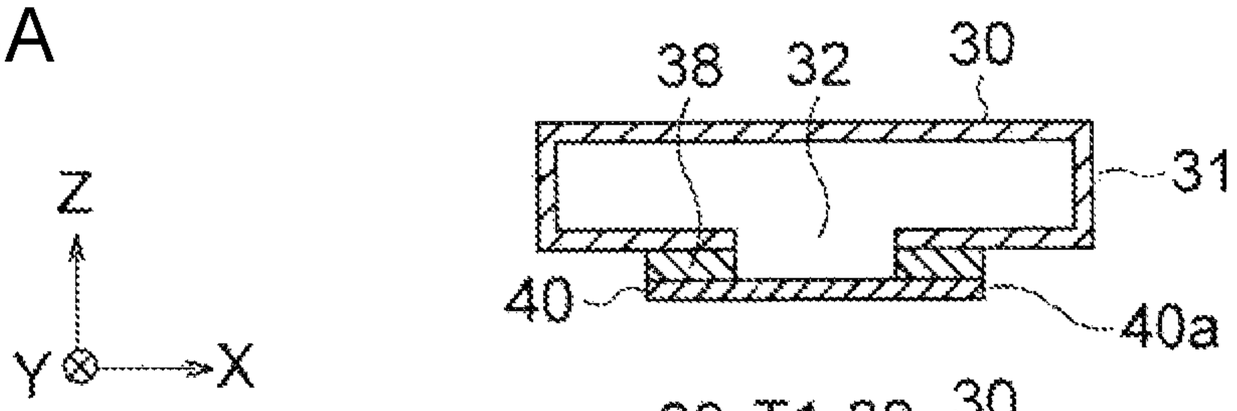


FIG. 28B

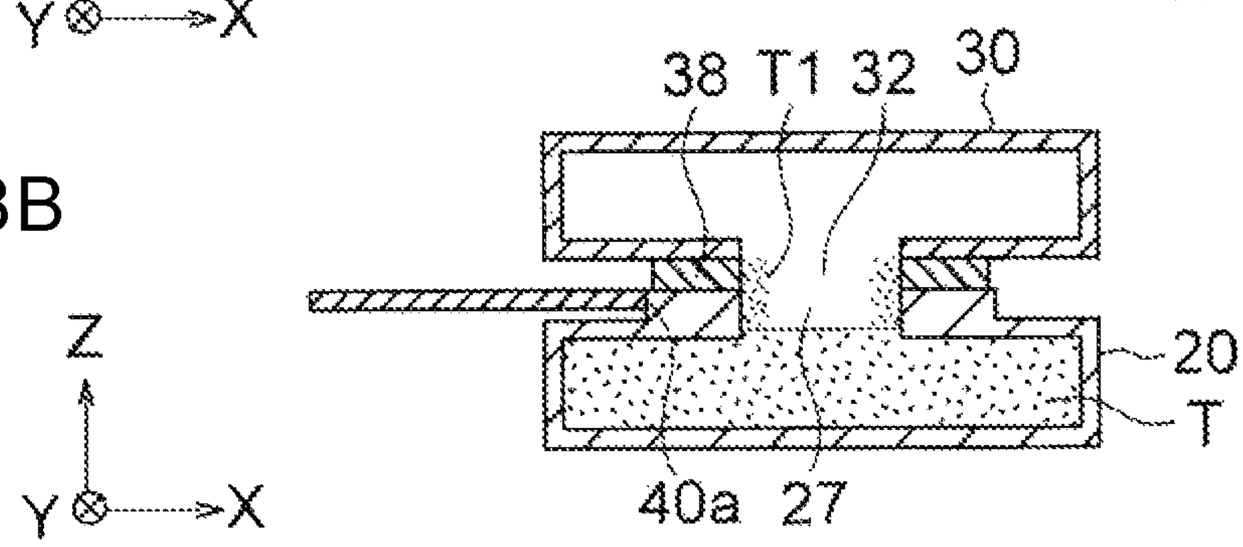


FIG. 28C

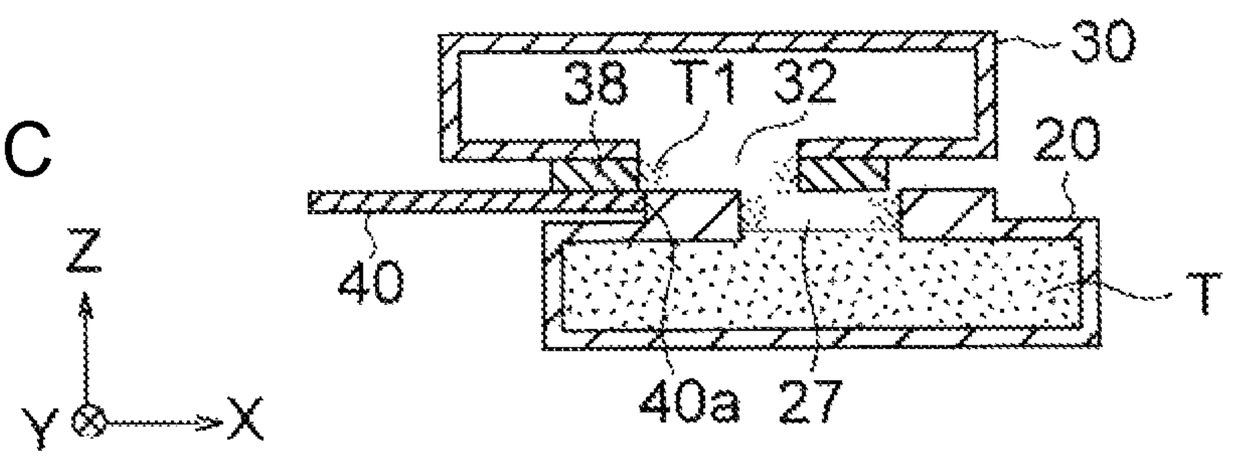


FIG. 28D

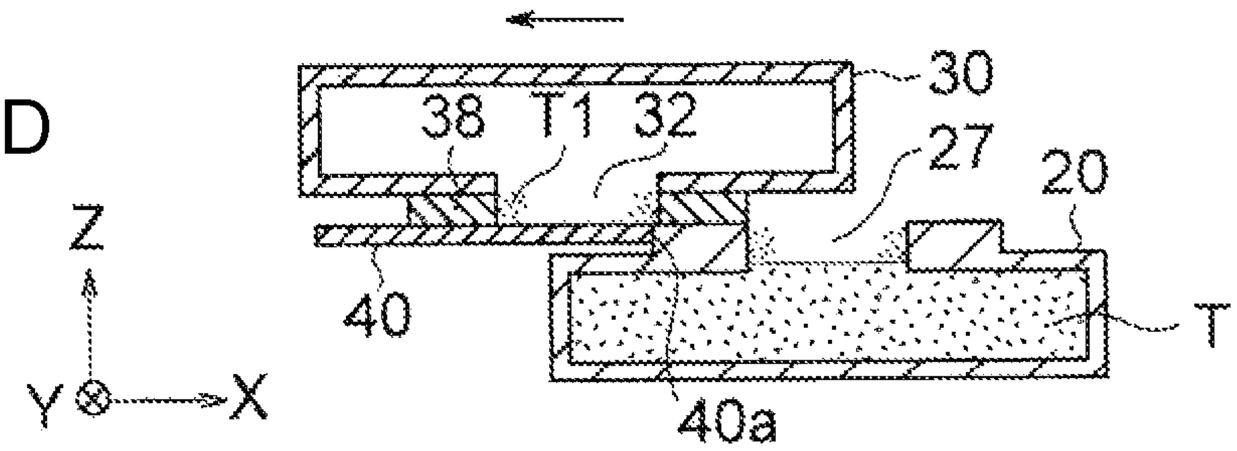


FIG. 28E

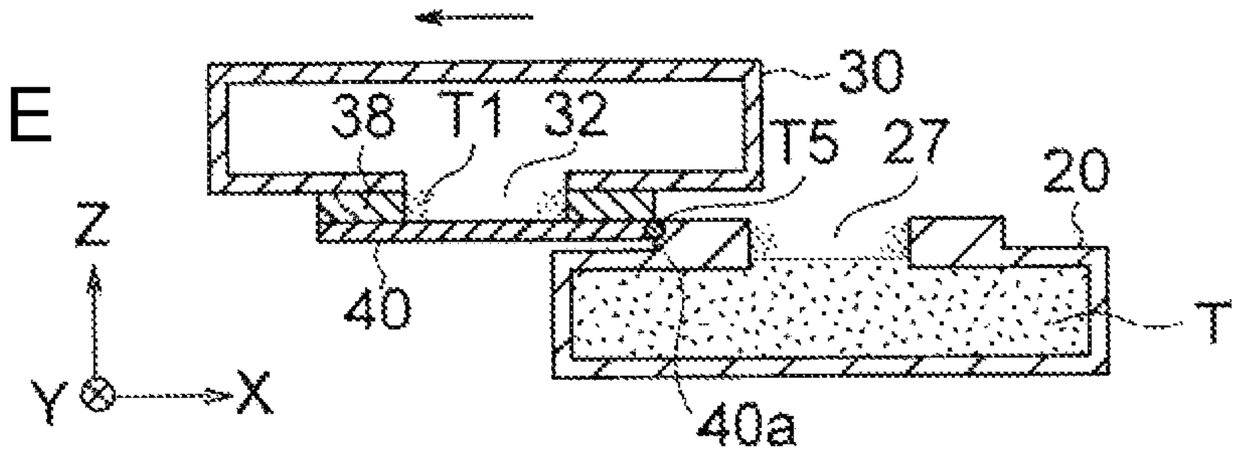


FIG. 28F

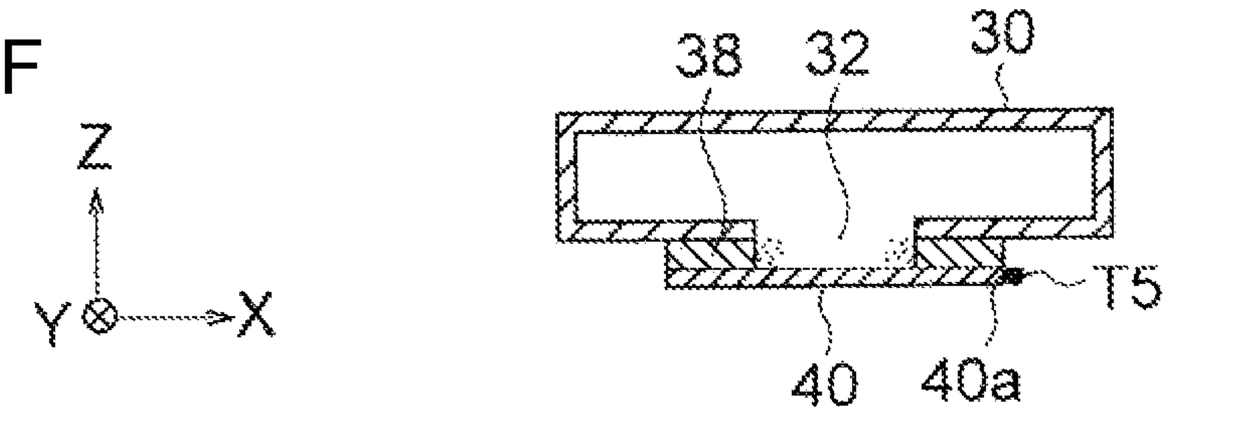
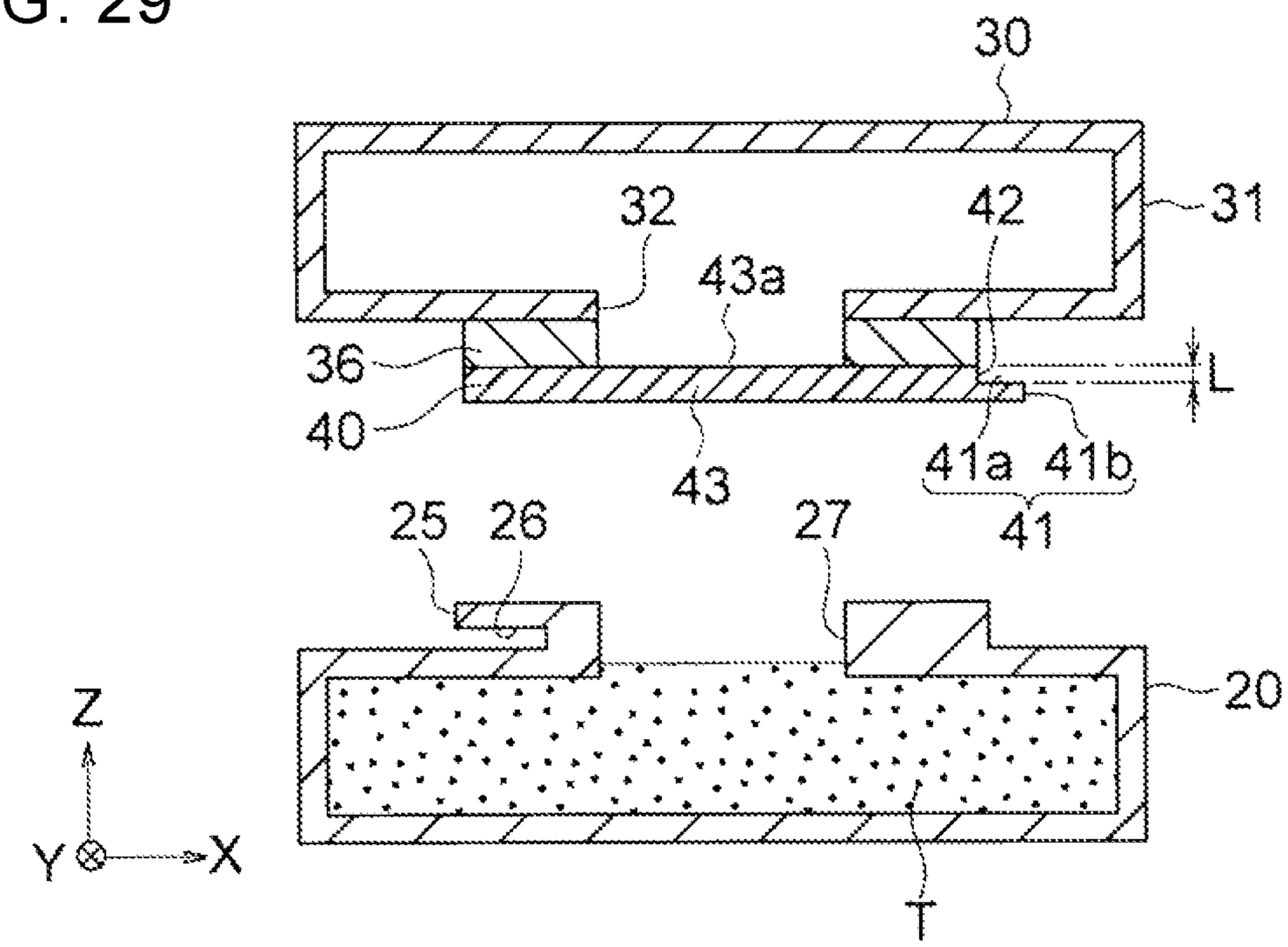


FIG. 29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X

FIG. 30

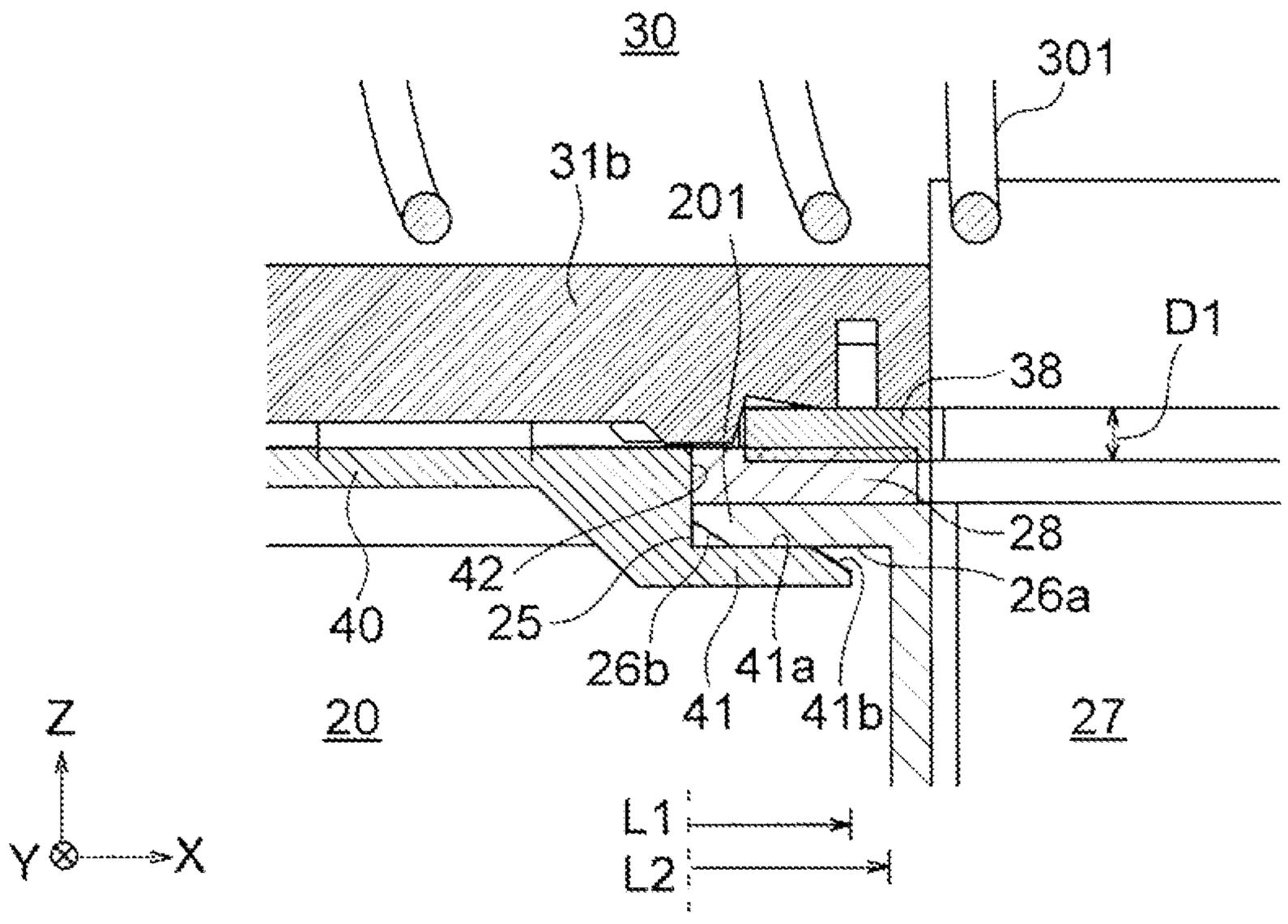
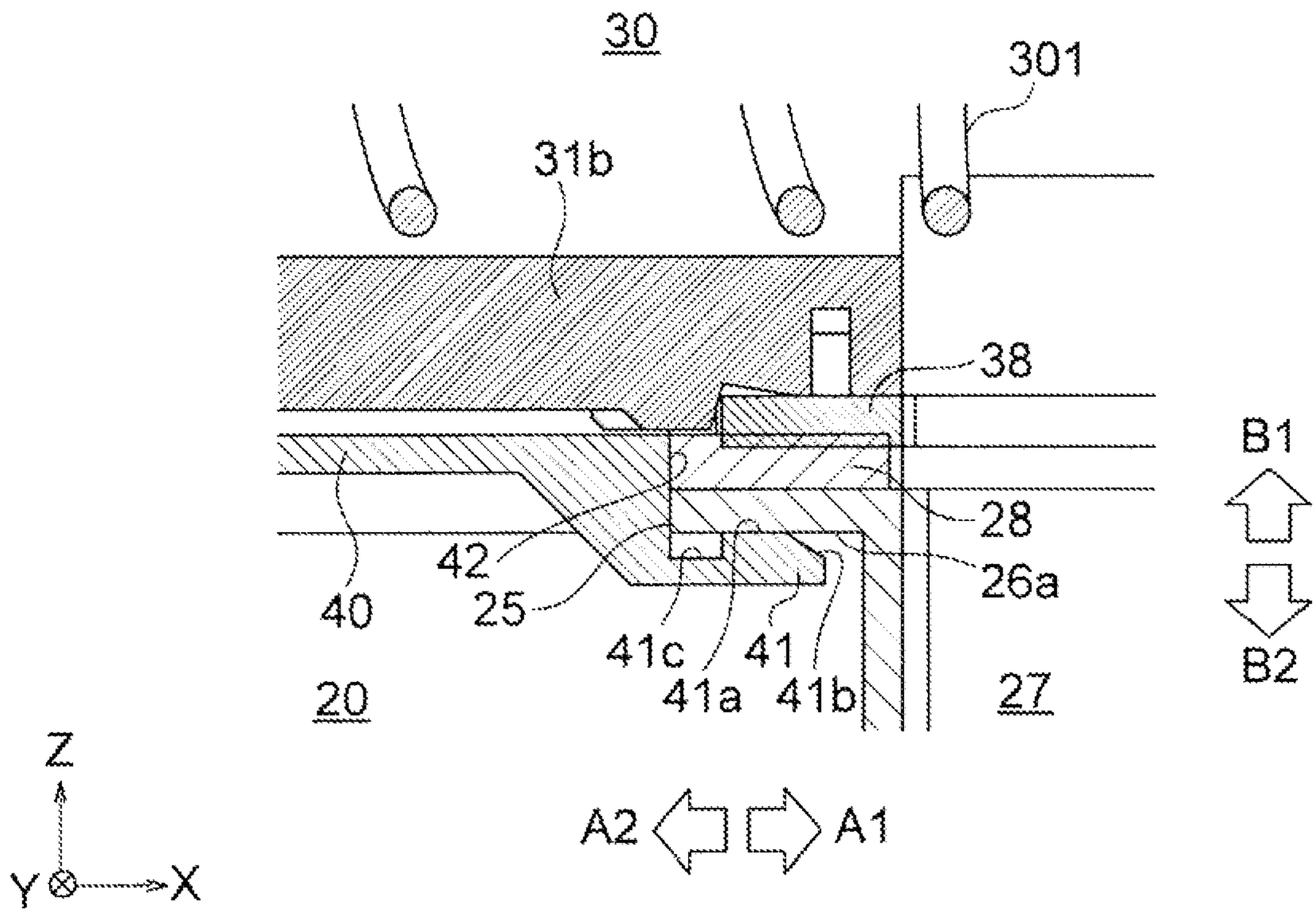

30
301
31b
201
D1
38
28
26a
42
25
40
26b
41a
41
41b
20
27
Z
Y
X
L1
L2

FIG. 31



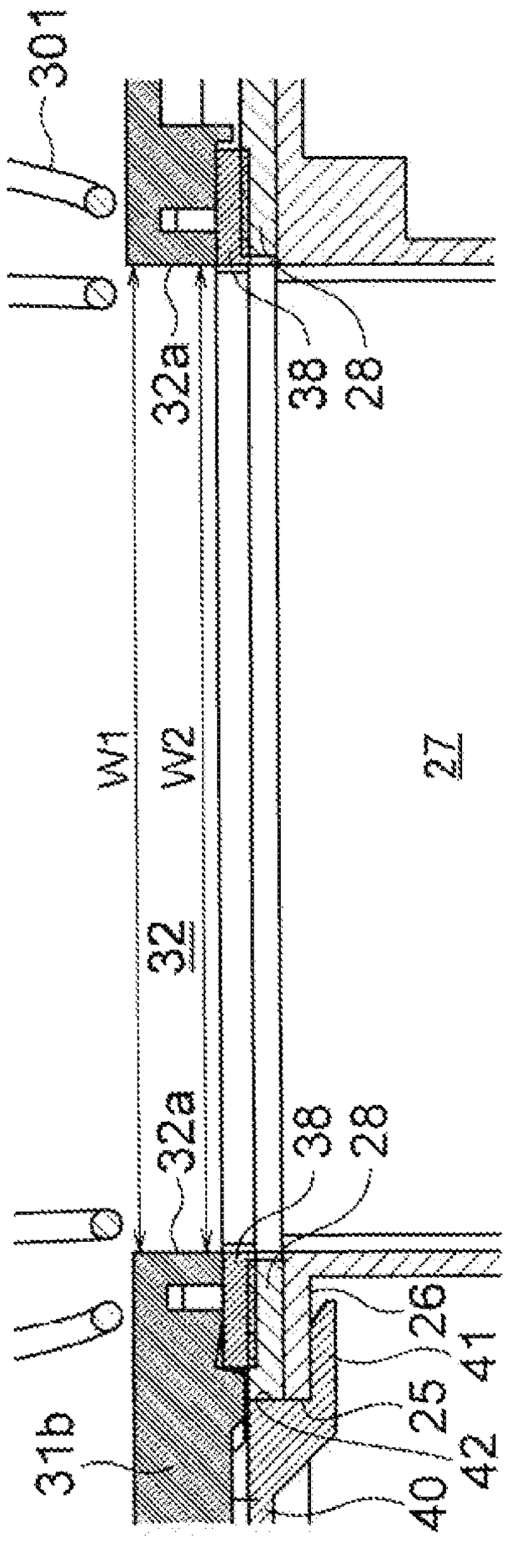


FIG. 32A

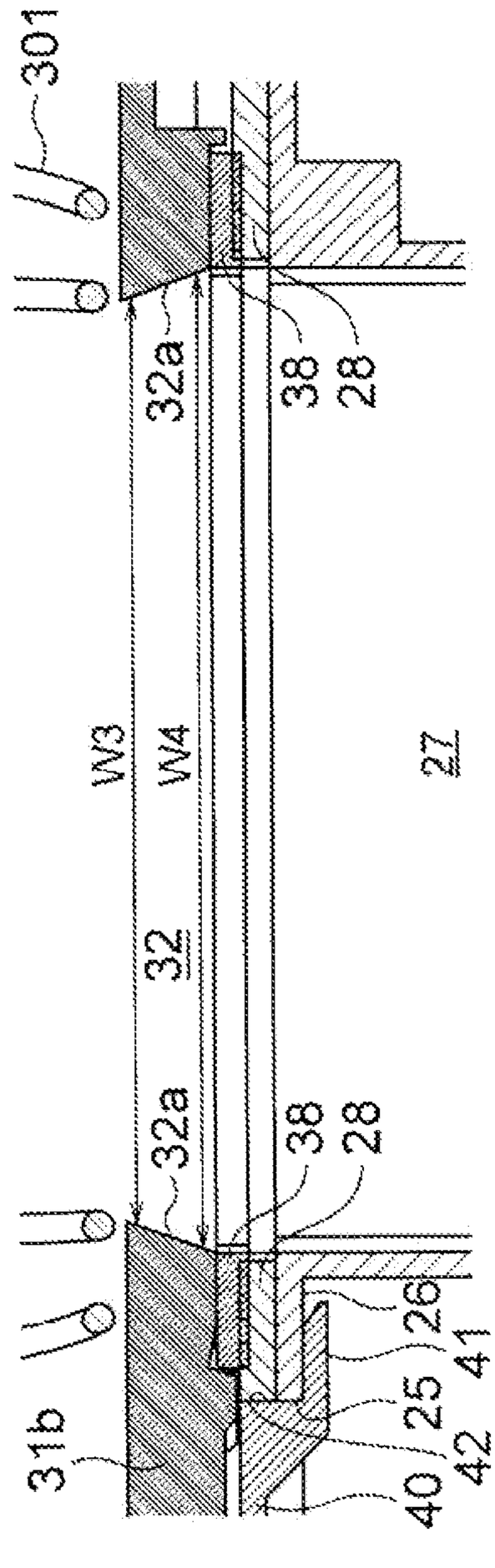


FIG. 32B

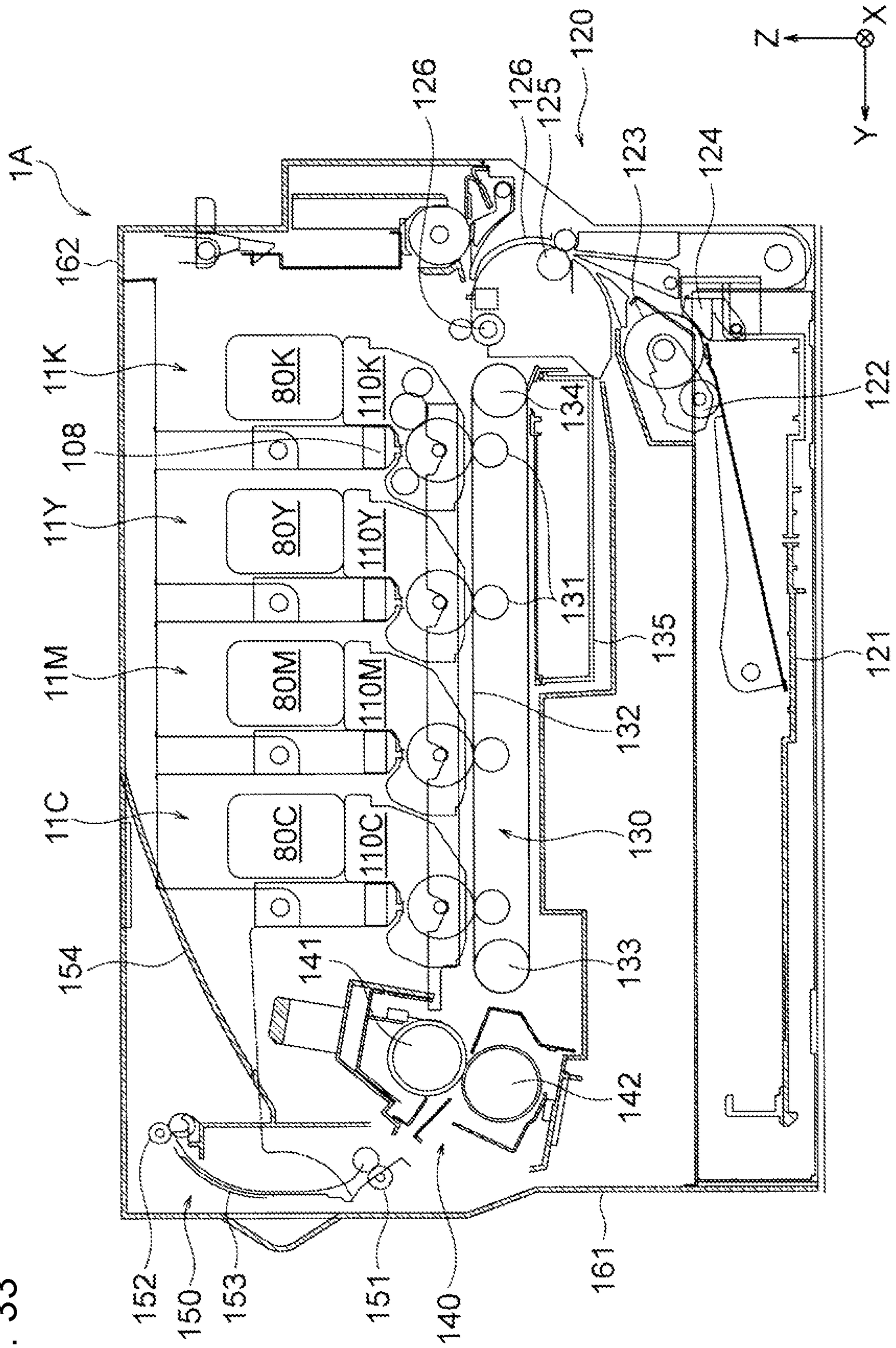
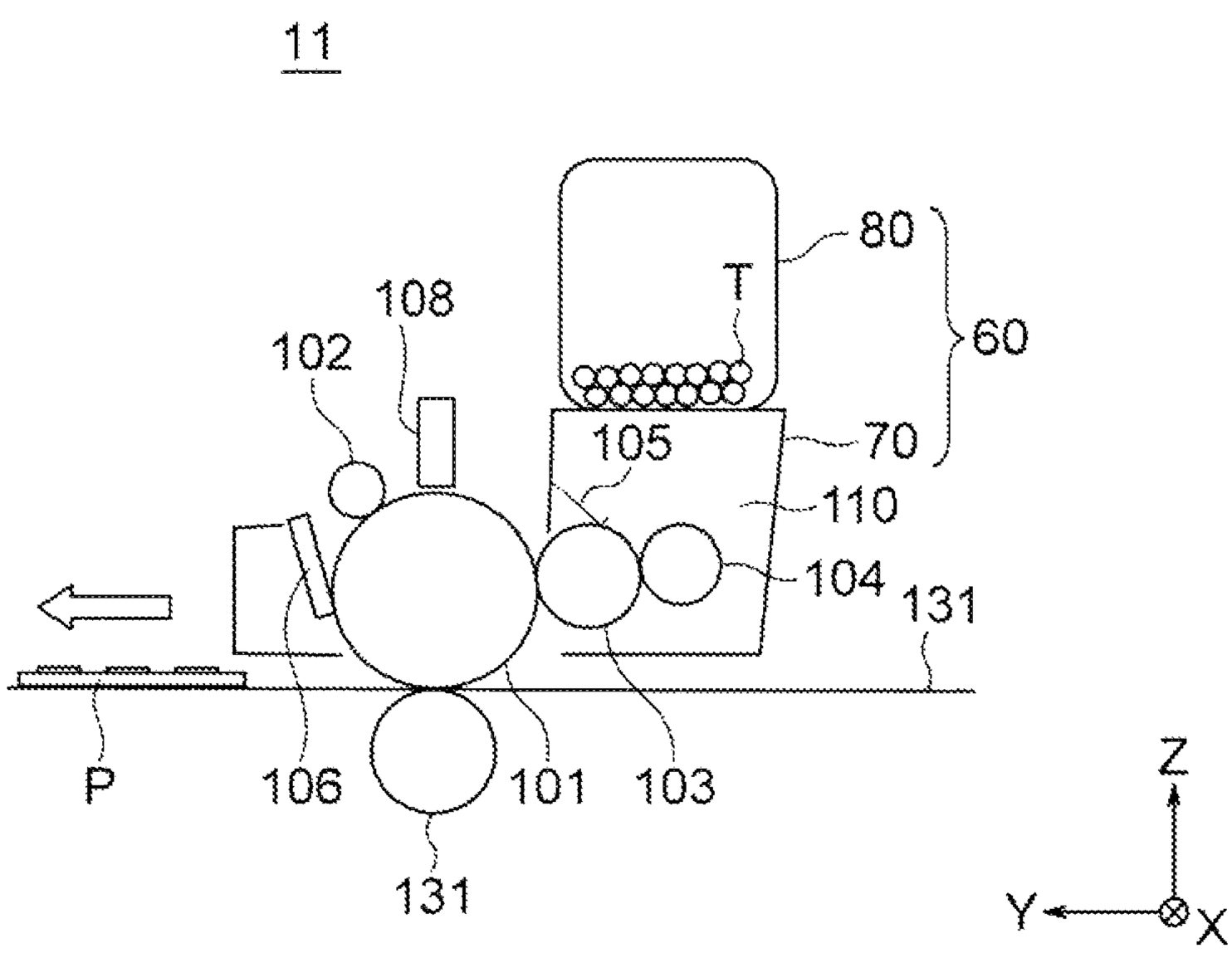

Z
X
Y
1A
162
11K
11Y
11M
11C
108
80K
80Y
80M
80C
110K
110Y
110M
110C
120
126
126
125
123
124
122
121
134
131
135
132
130
133
142
141
154
152
150
153
151
140
161

FIG. 33

FIG. 34



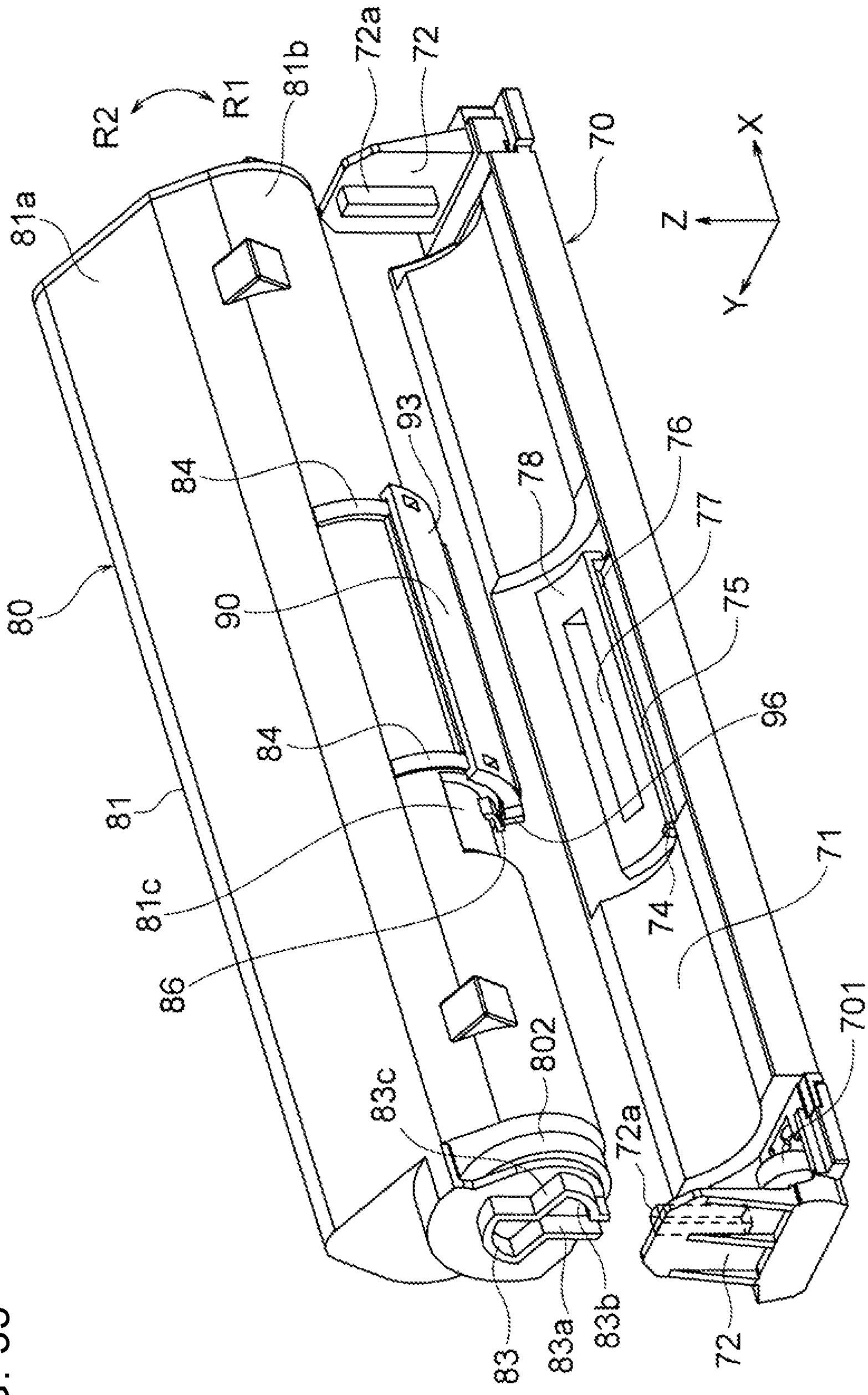

R2
R1
81b
72a
72
70
81a
X
Z
Y
80
84
93
78
76
77
75
90
84
96
81
81c
74
71
86
802
701
83c
80
72a
83
83a
83b
72

FIG. 35

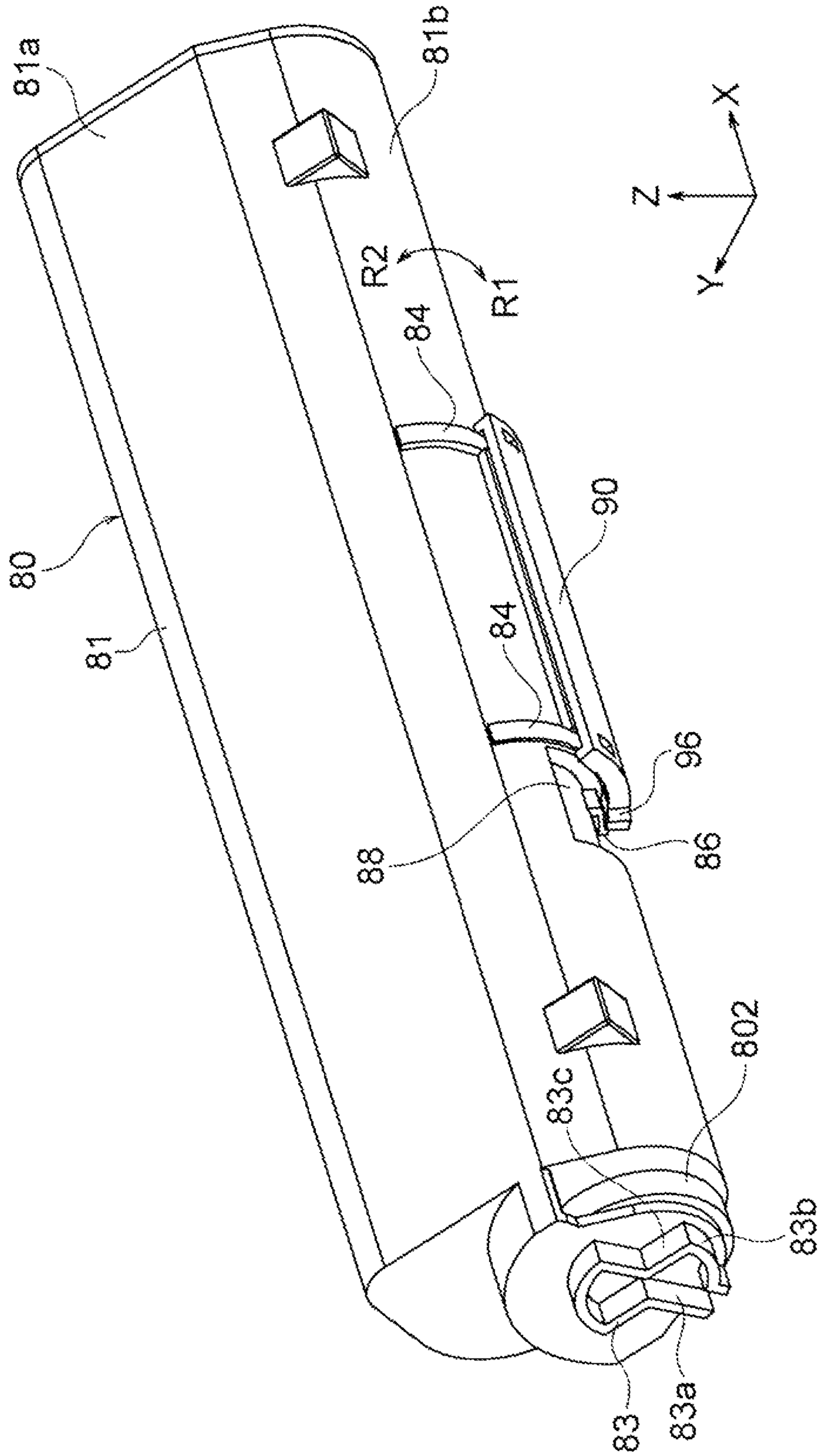


FIG. 36

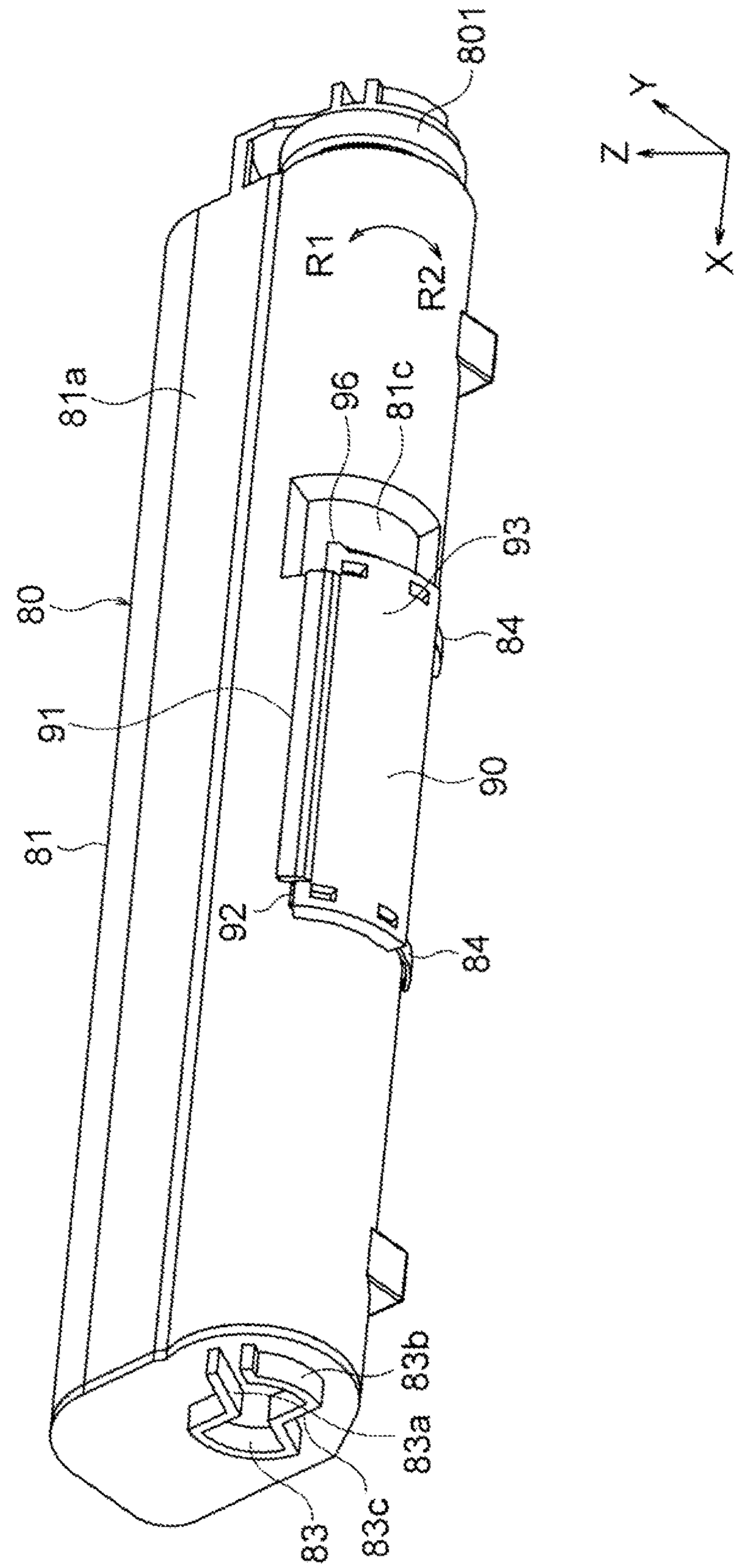


FIG. 37

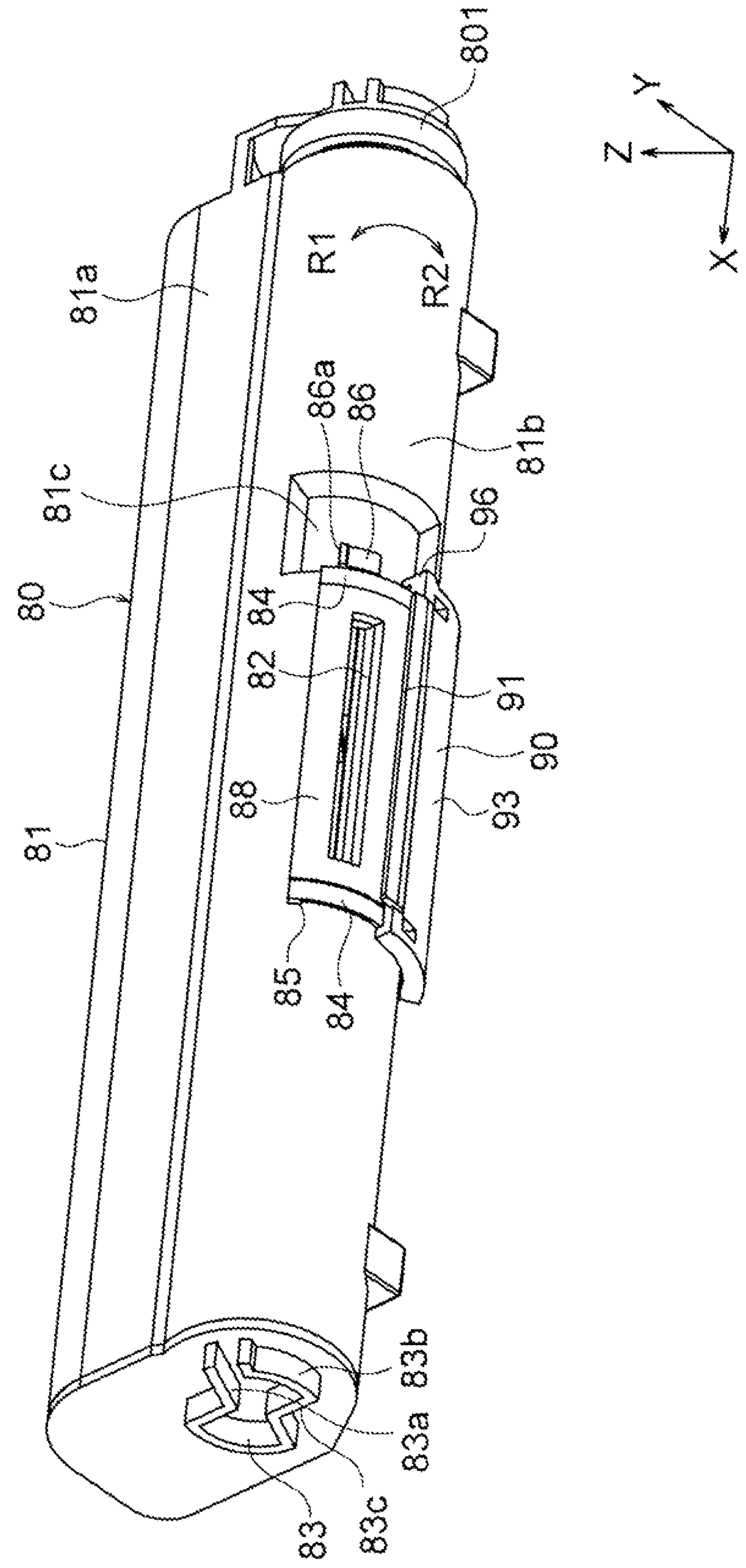

801
Y
Z
X
R1
R2
81a
86a
86
81b
81c
96
80
84
82
91
90
88
93
81
85
84
83b
83a
83
83c

FIG. 38

FIG. 39

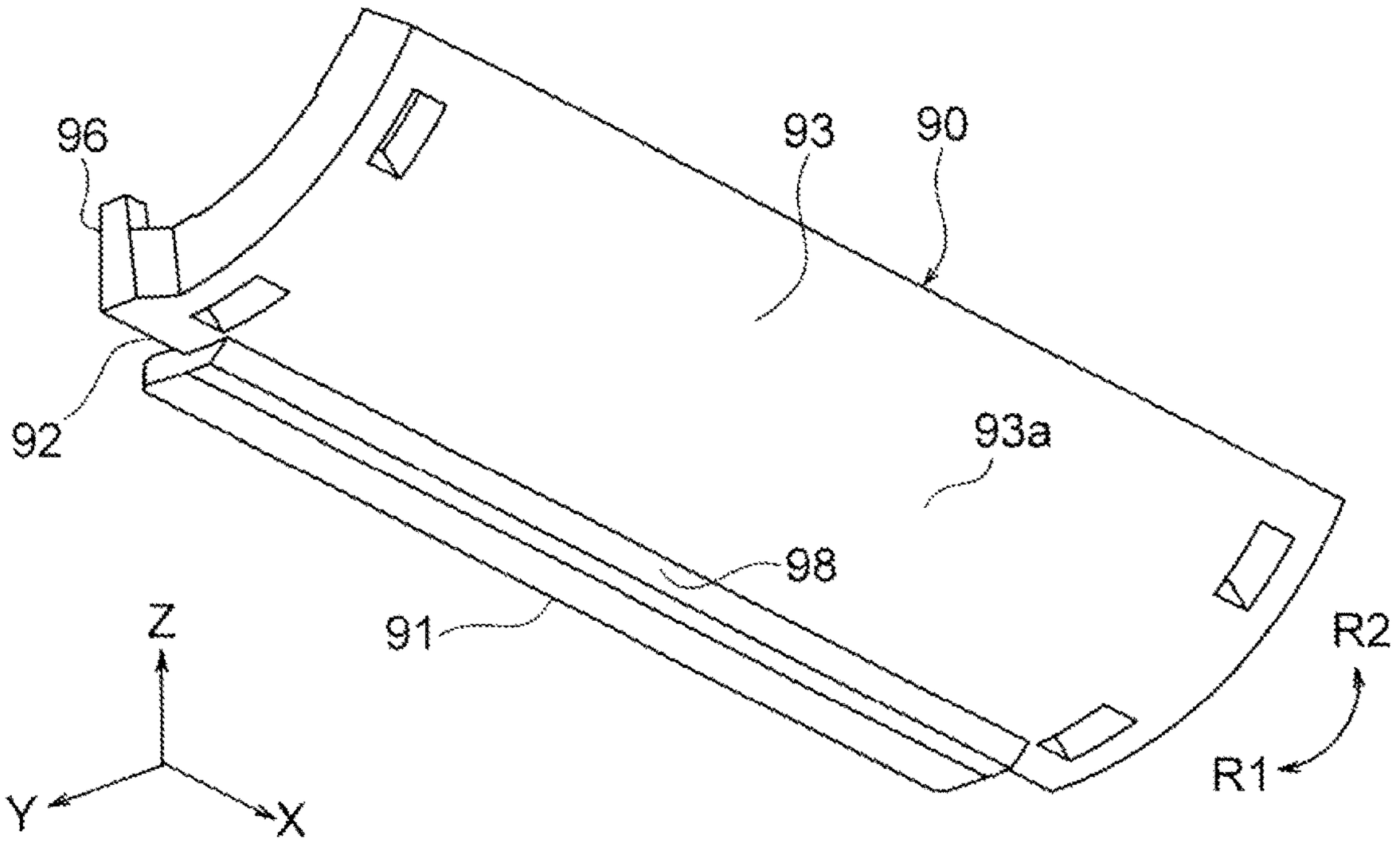

96
93
90
92
93a
98
91
Z
R2
R1
Y
X

FIG. 40

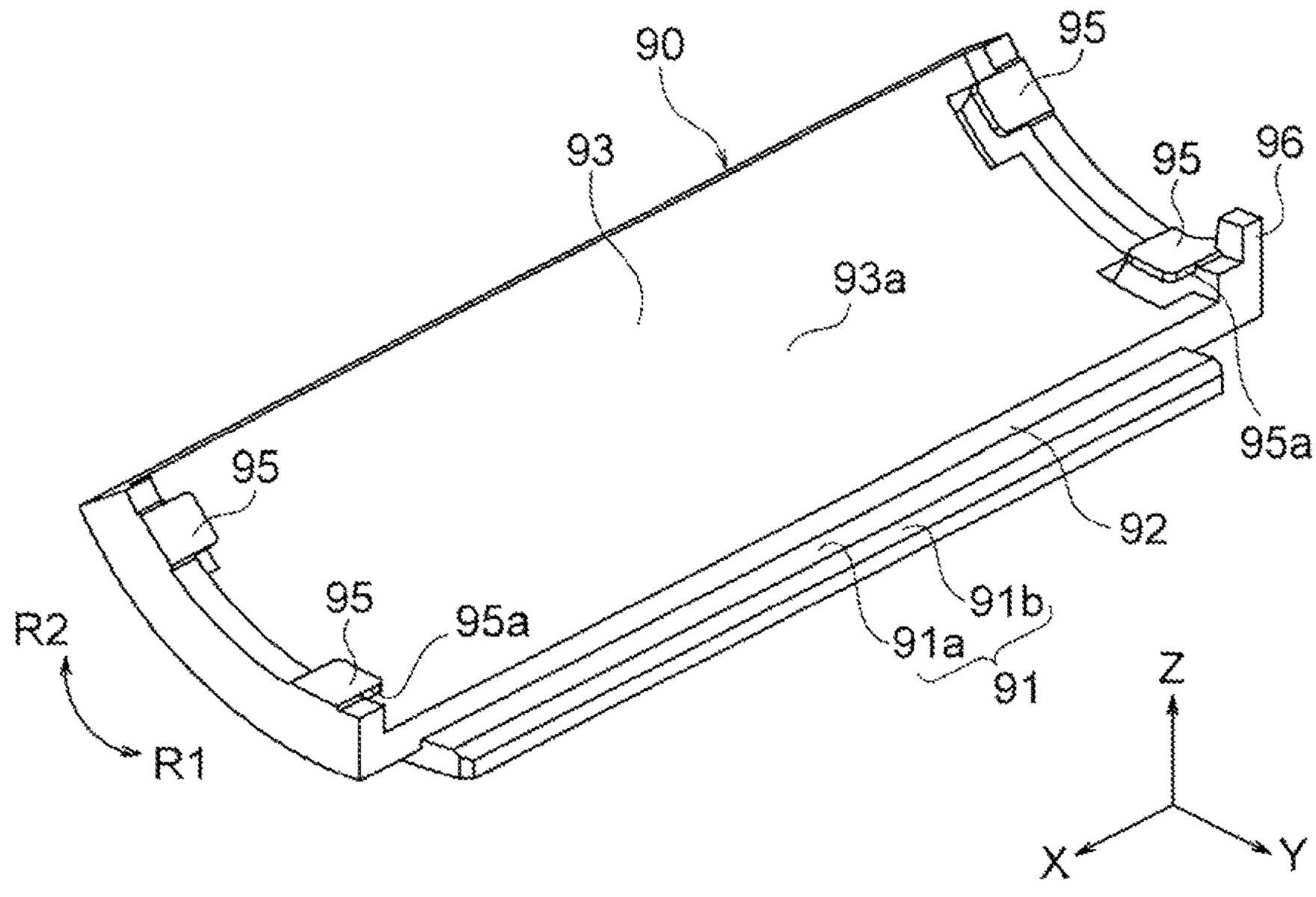

90
95
93
95
96
93a
95a
95
92
95
95a
91b
91a
91
R2
R1
Z
X
Y

FIG. 41B

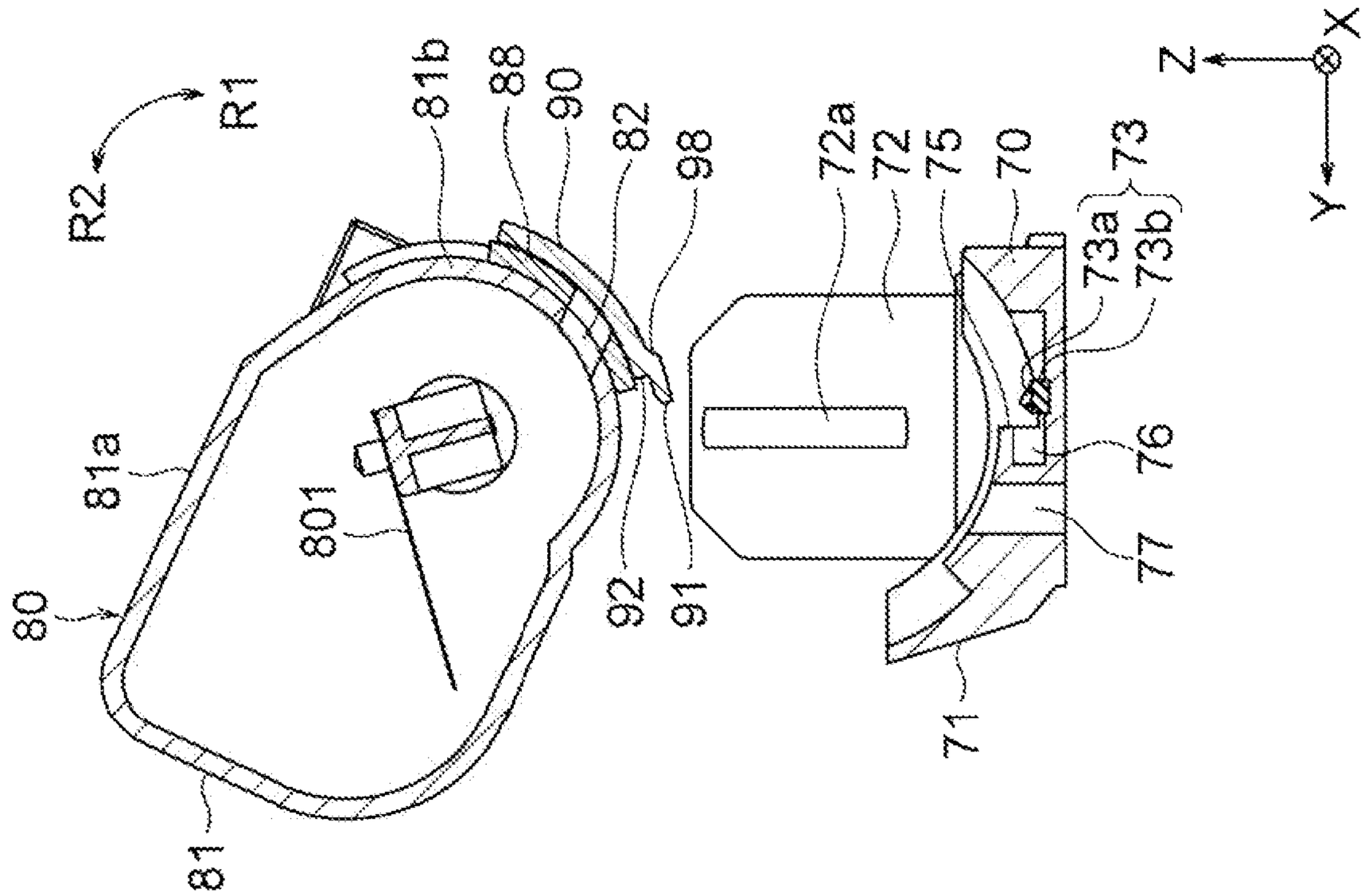


FIG. 41A

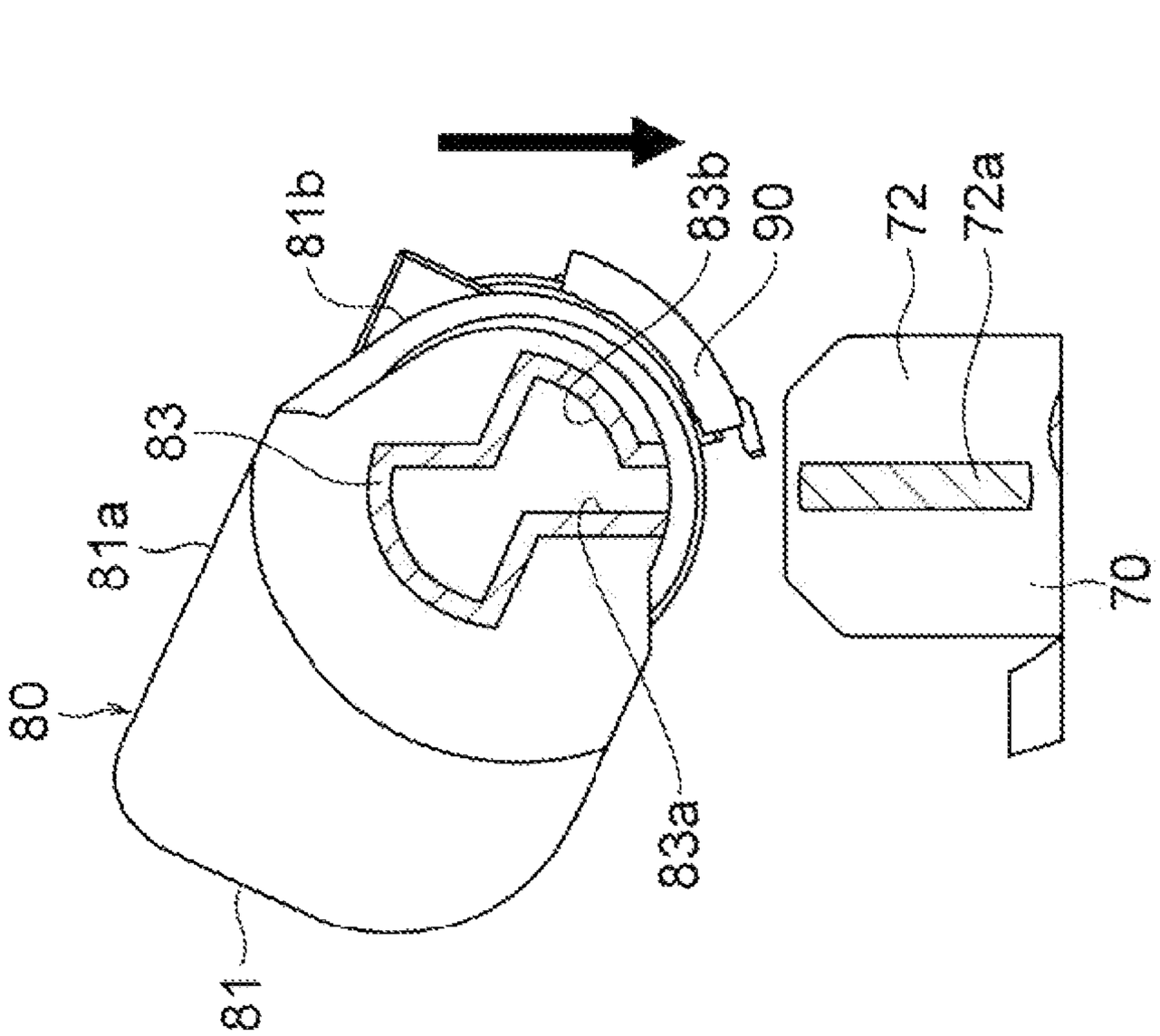


FIG. 42B

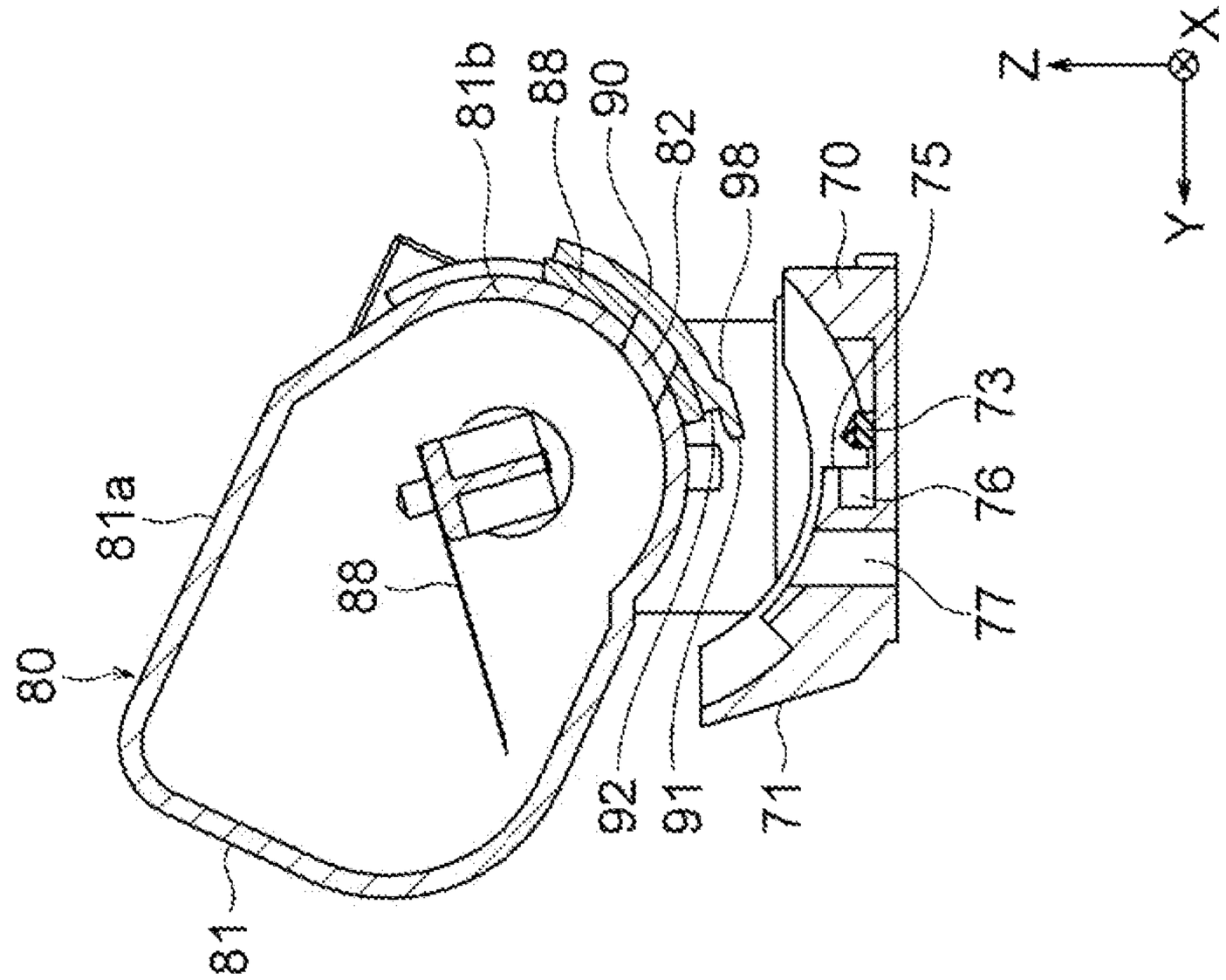


FIG. 42A

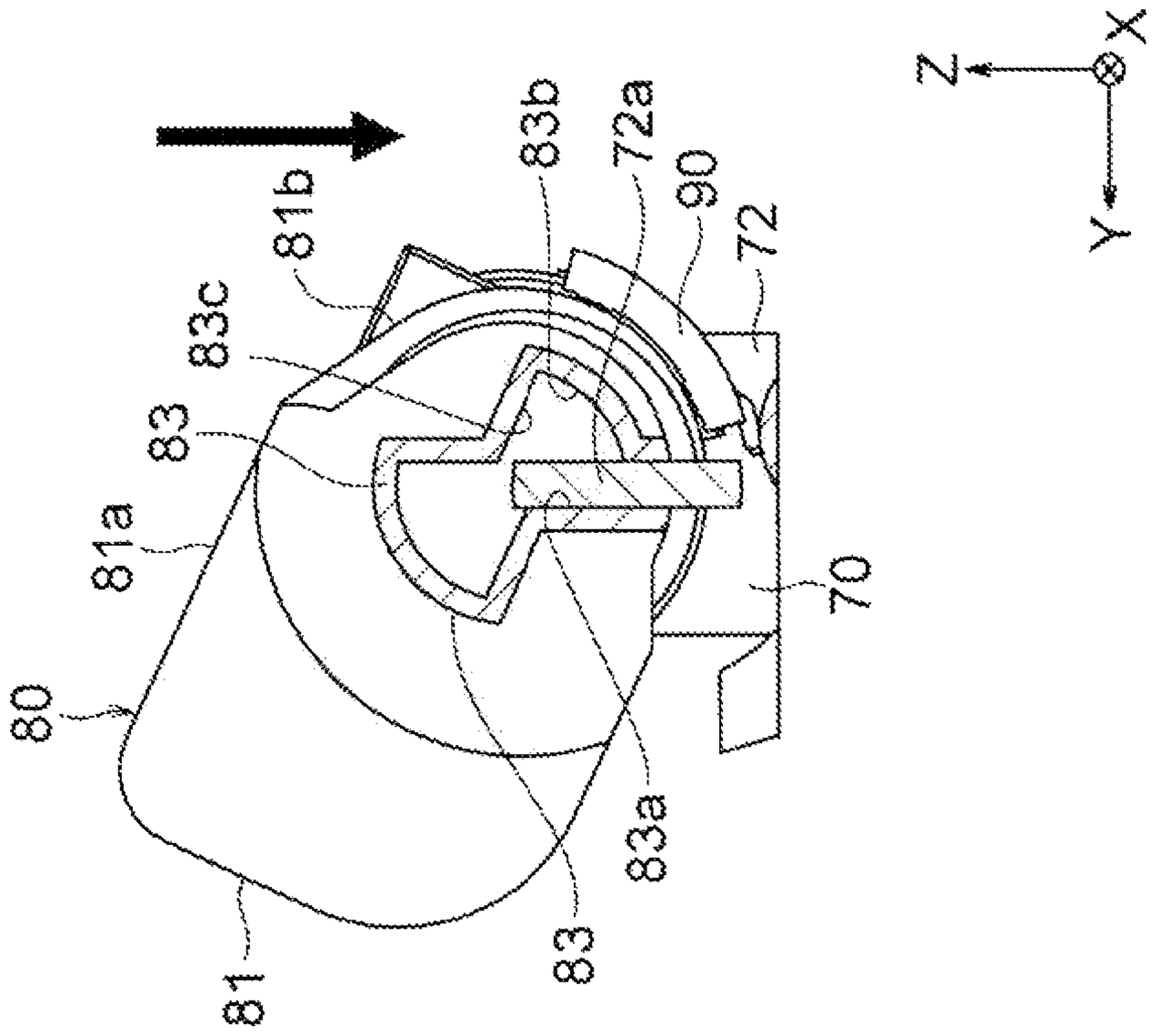


FIG. 43A

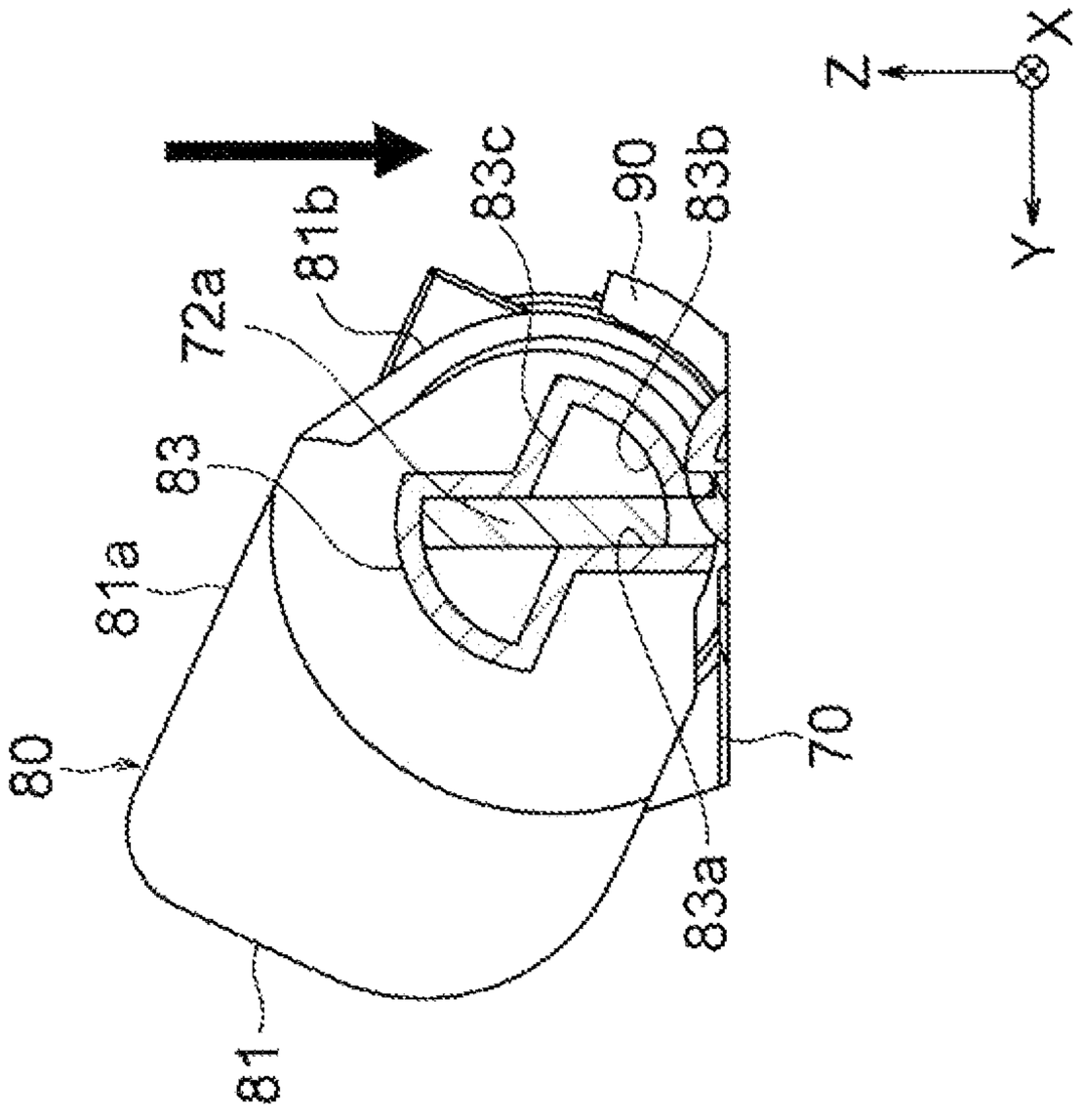


FIG. 43B

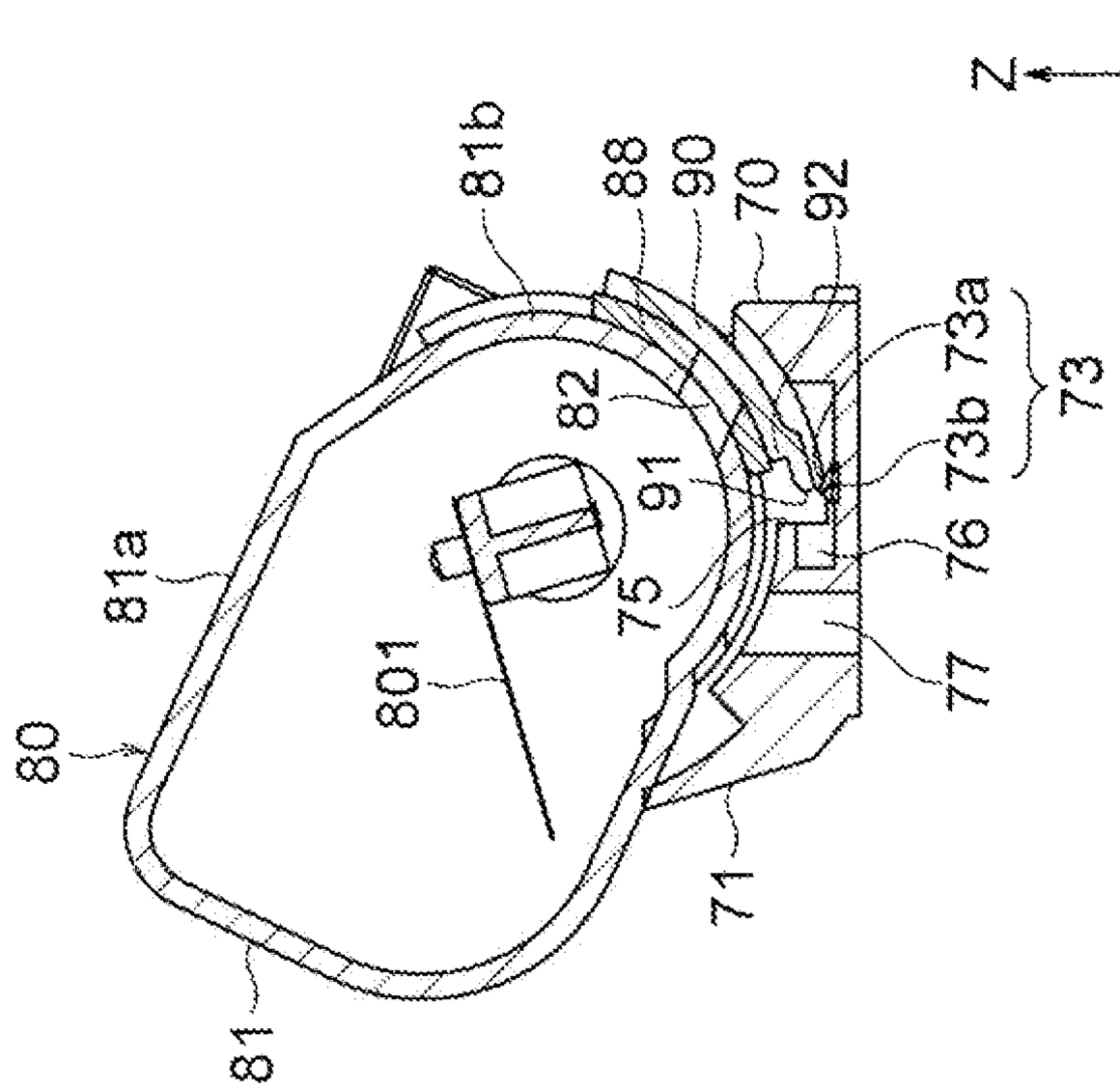


FIG. 44A

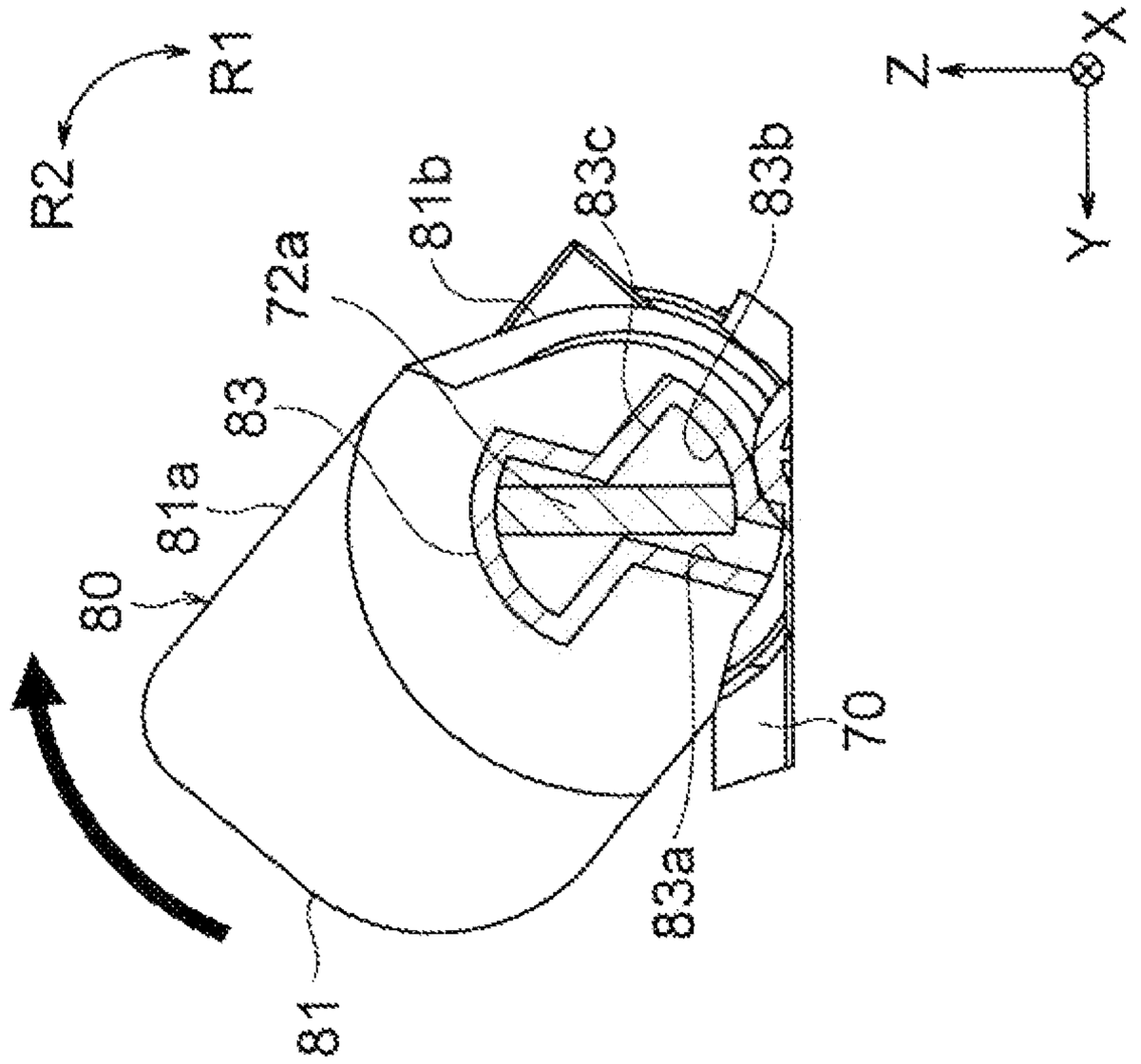


FIG. 44B

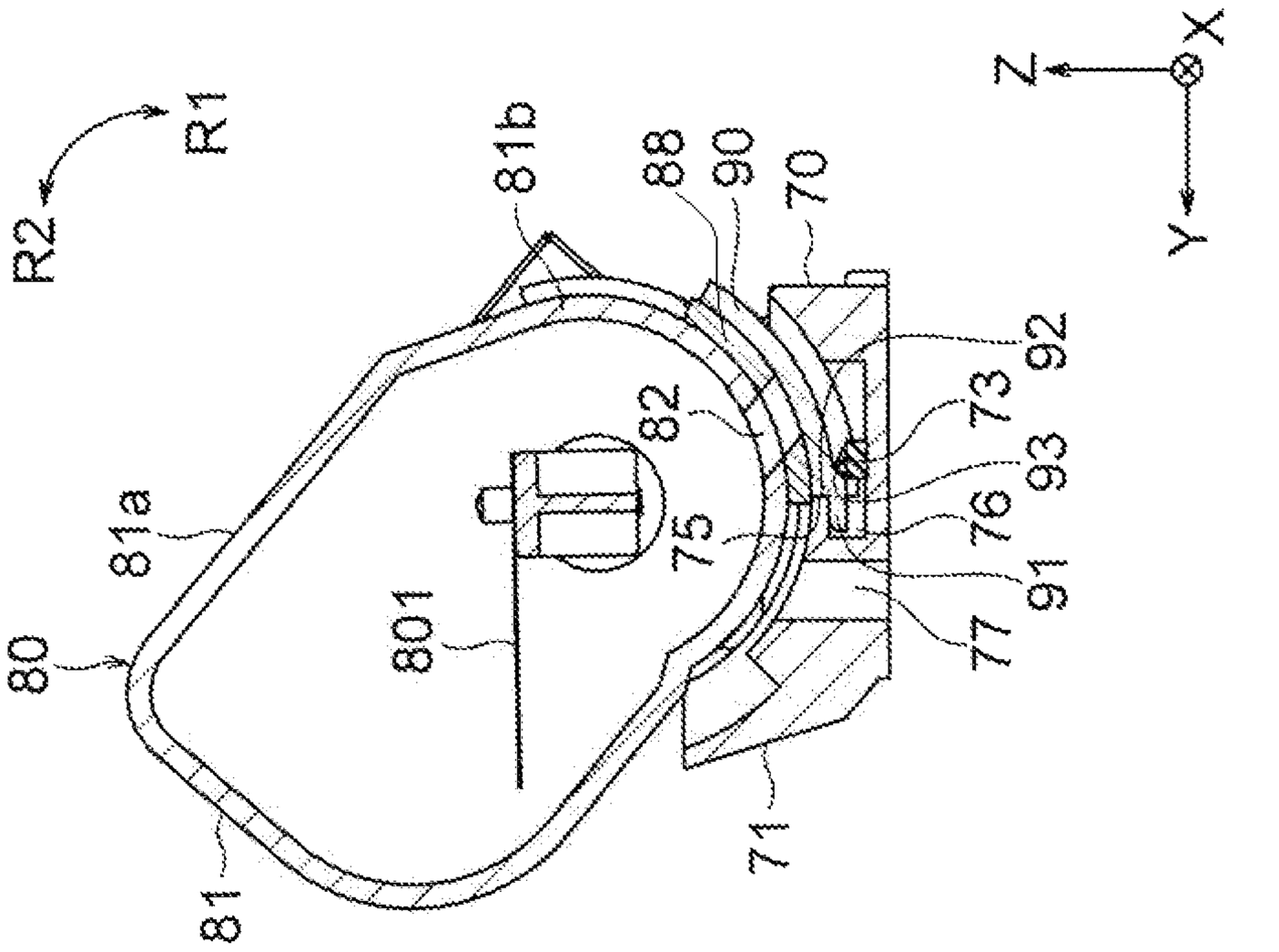


FIG. 45B

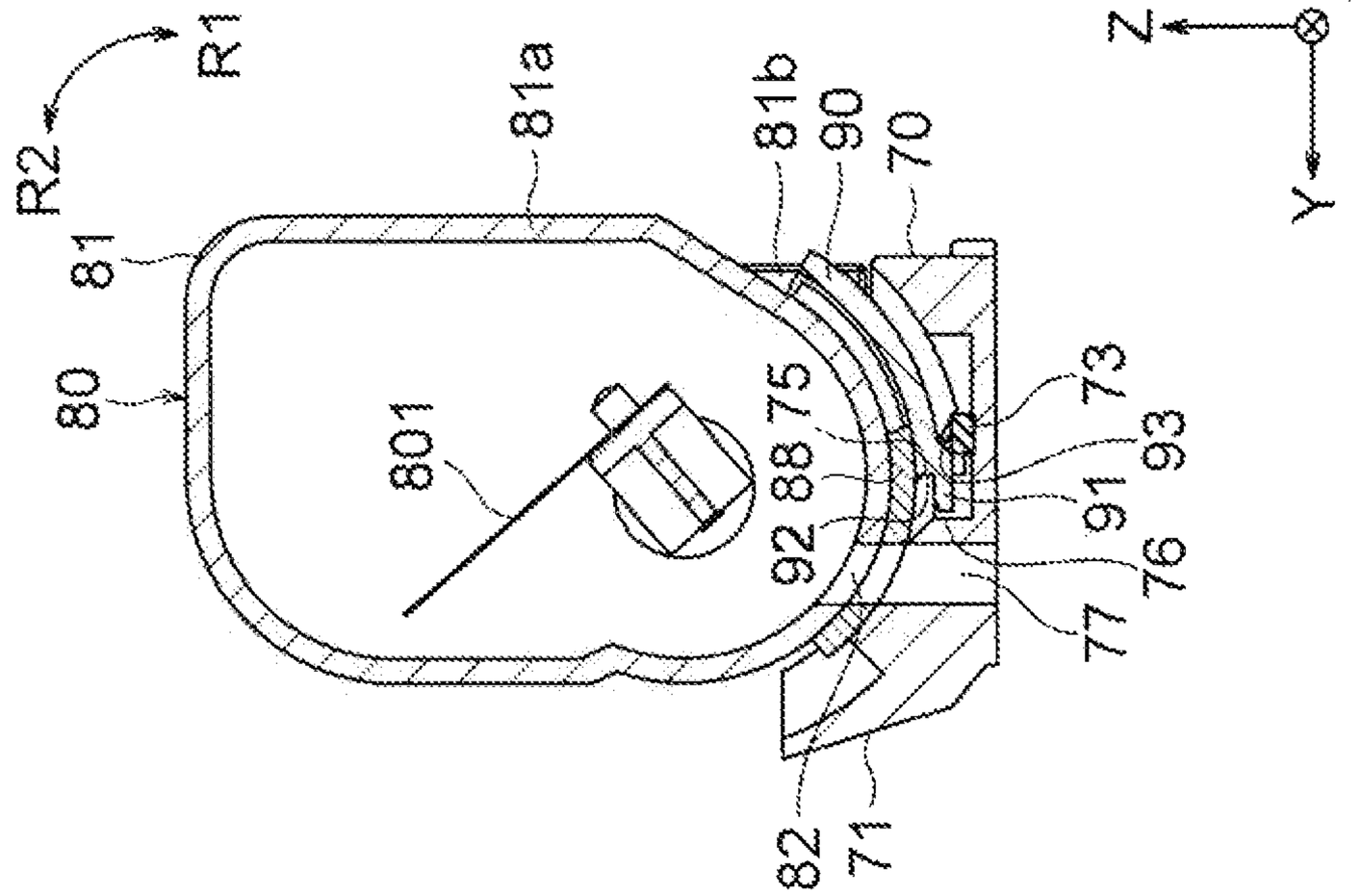


FIG. 45A

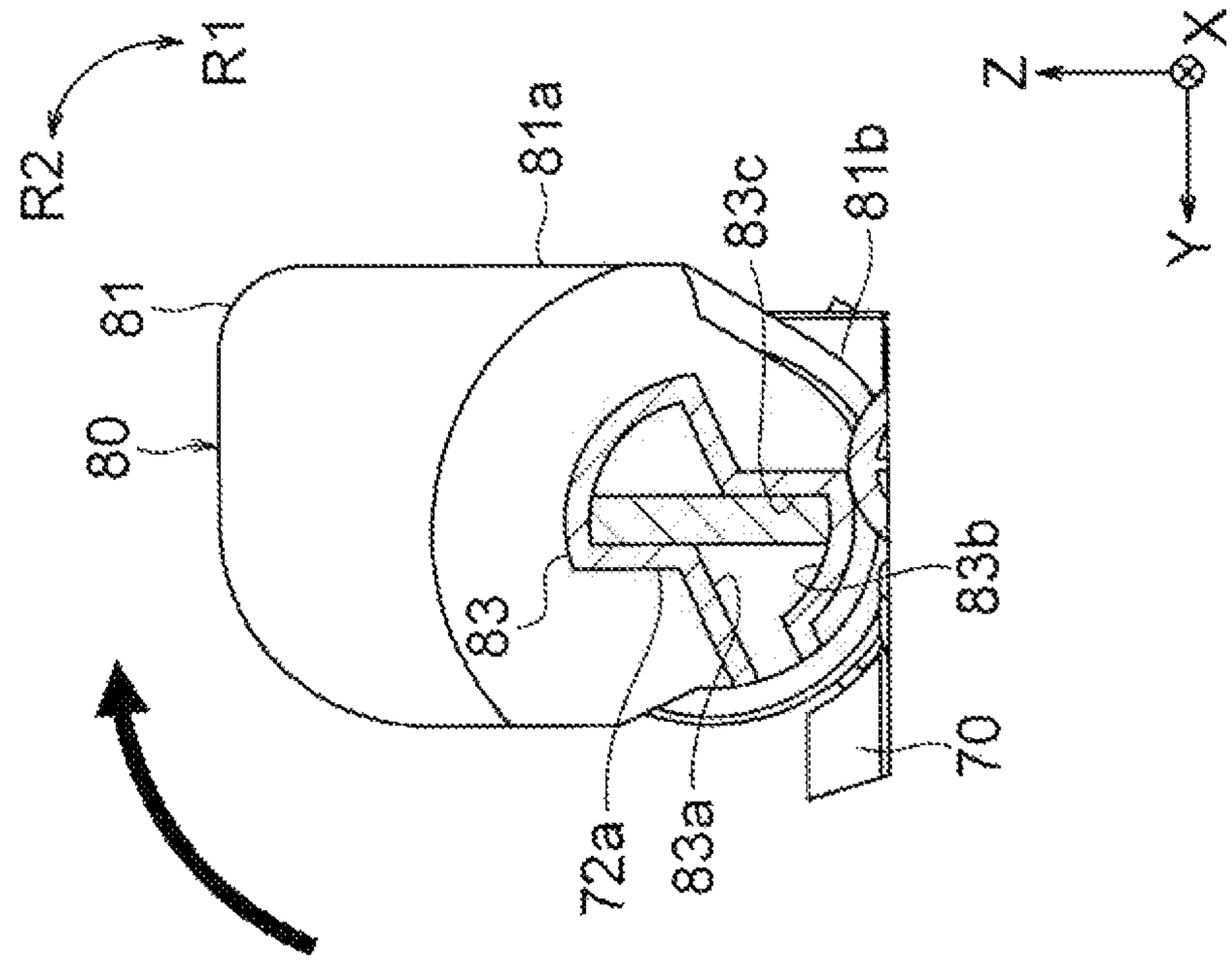


FIG. 46C

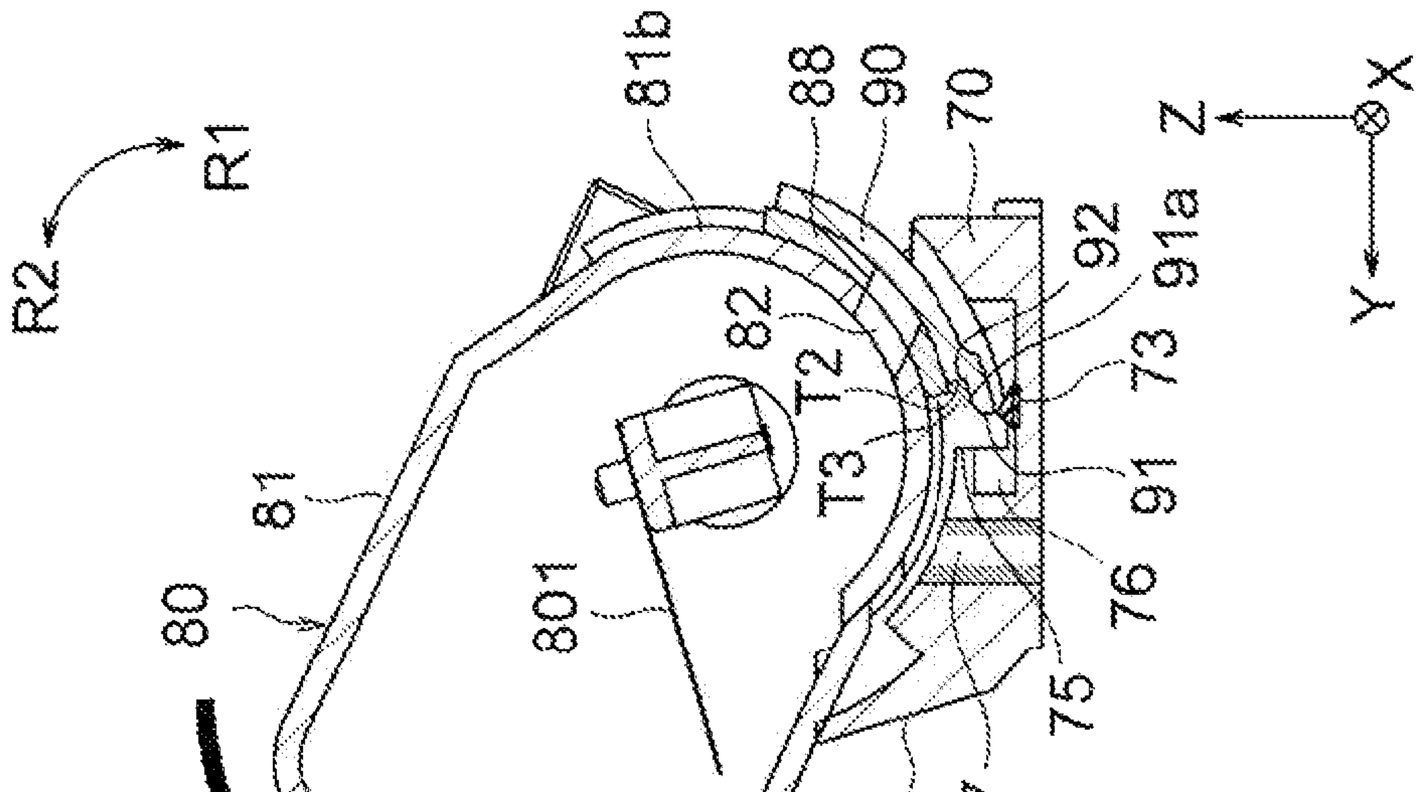


FIG. 46B

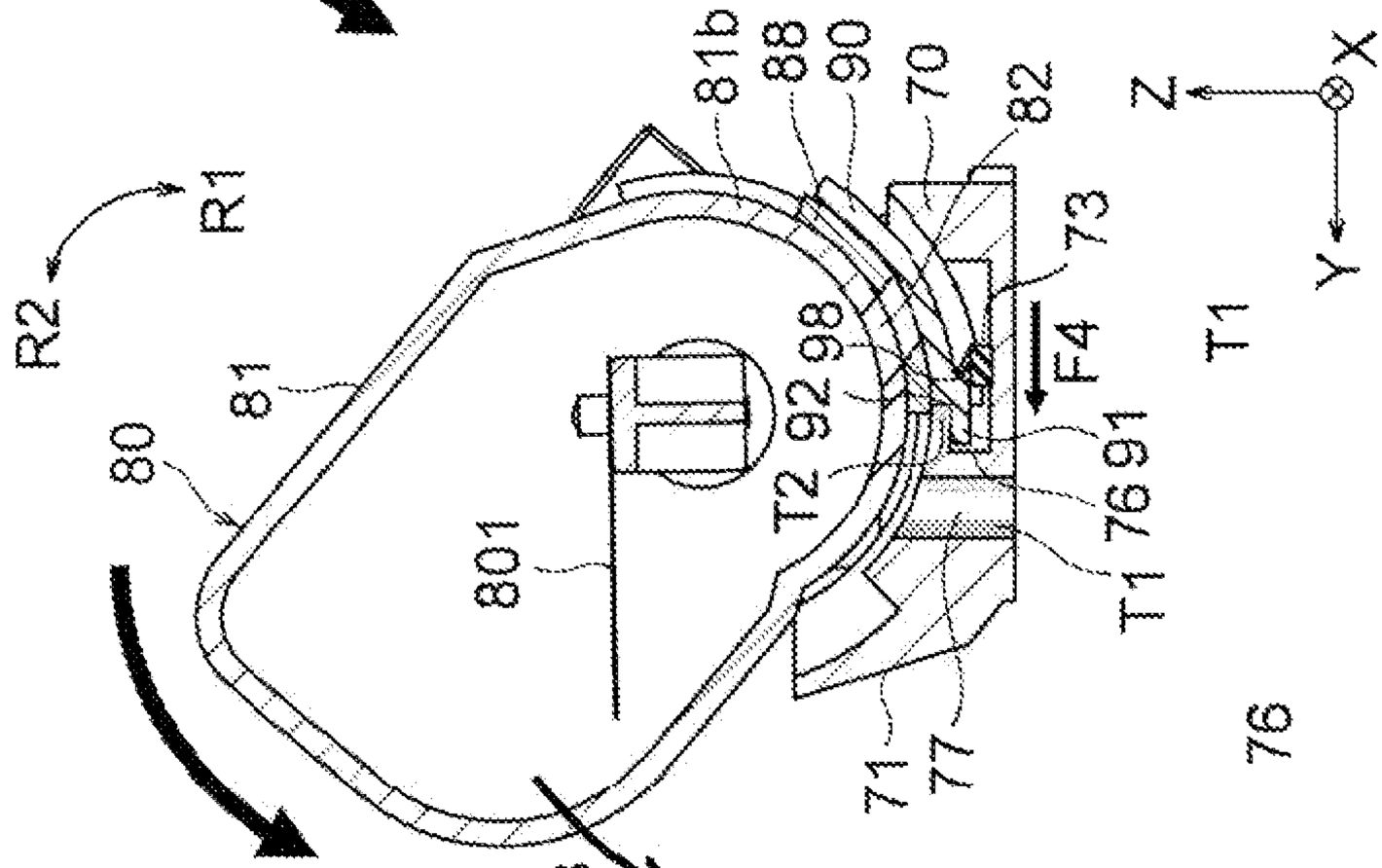


FIG. 46A

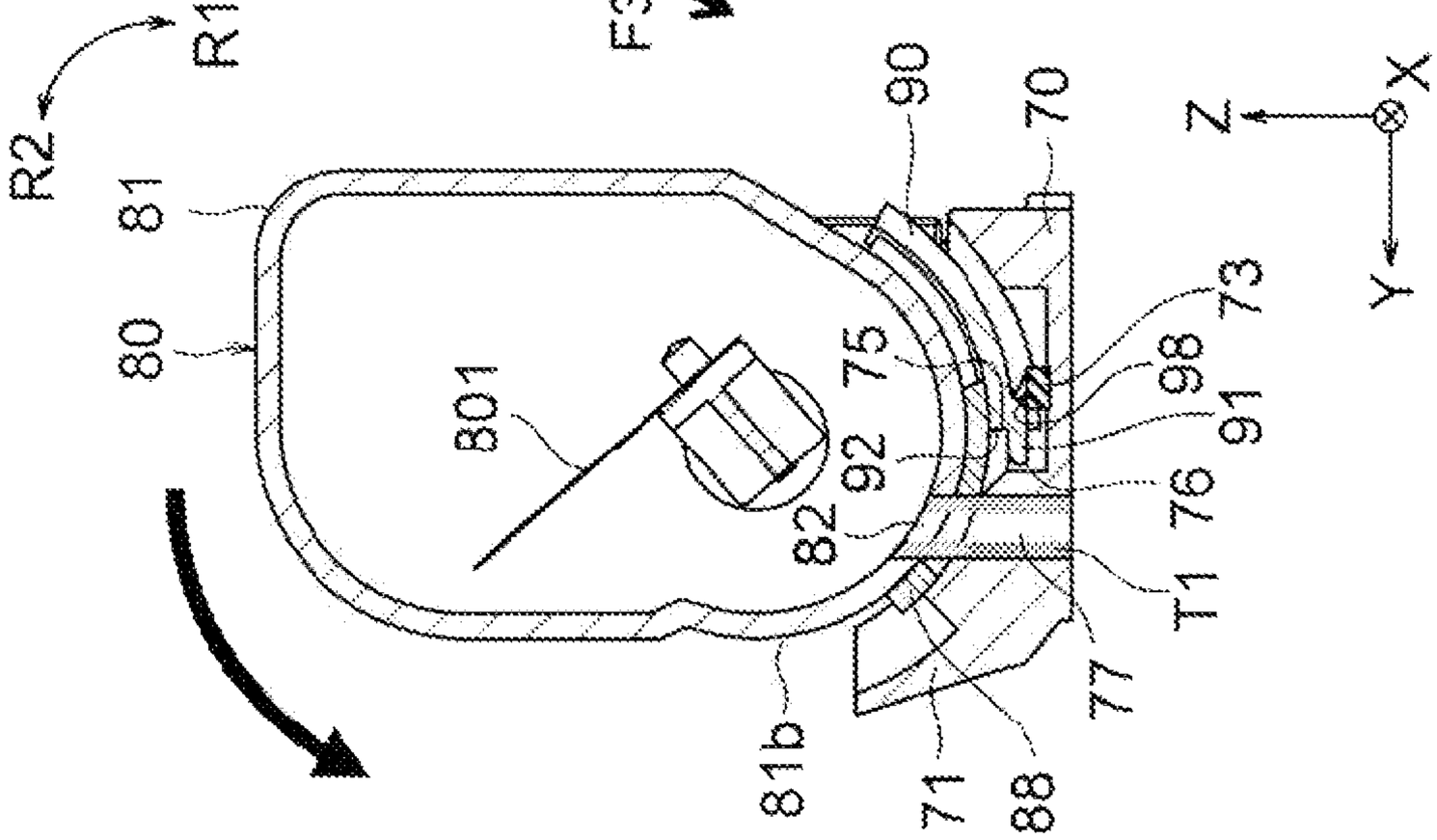


FIG. 47

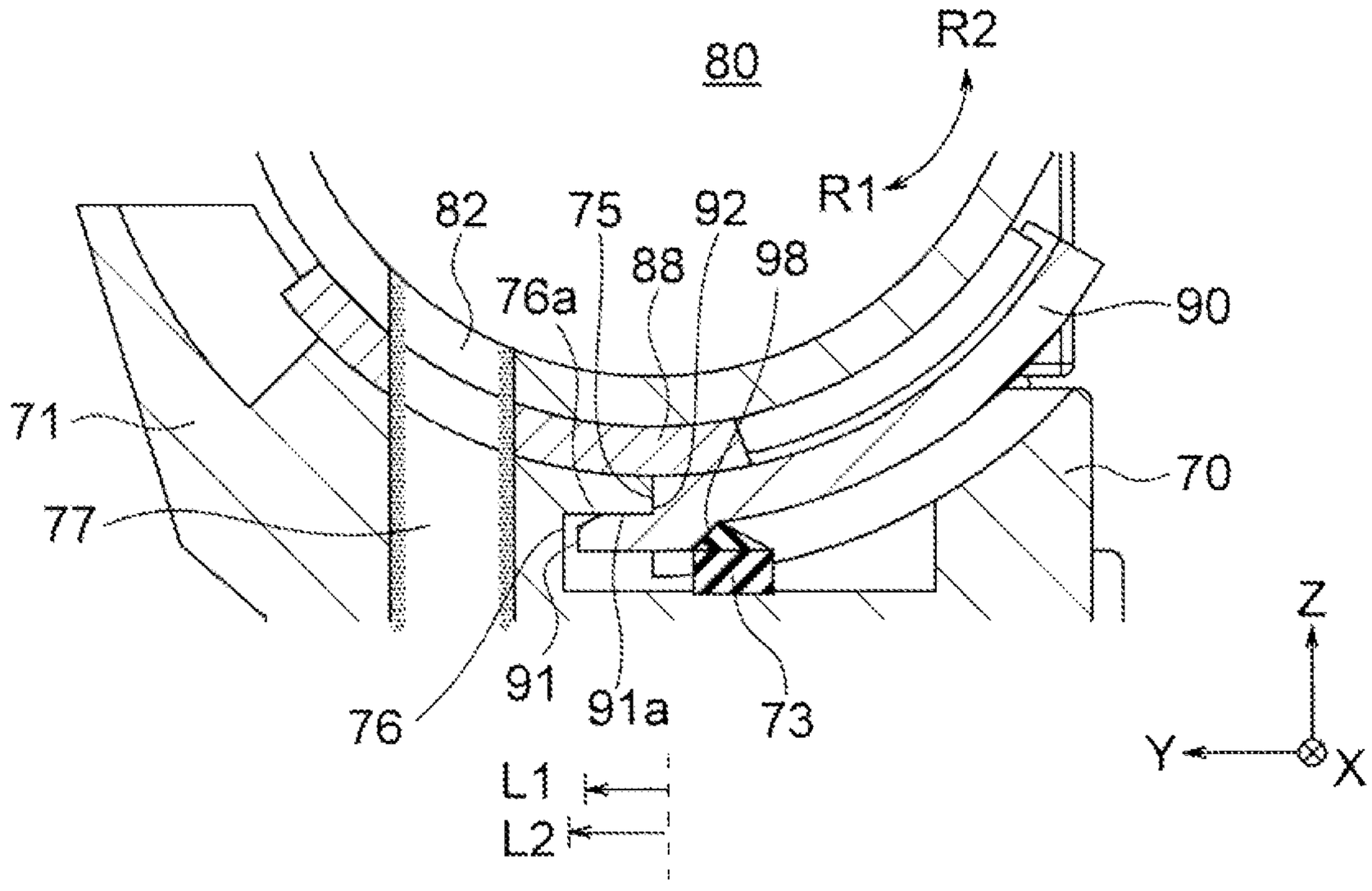
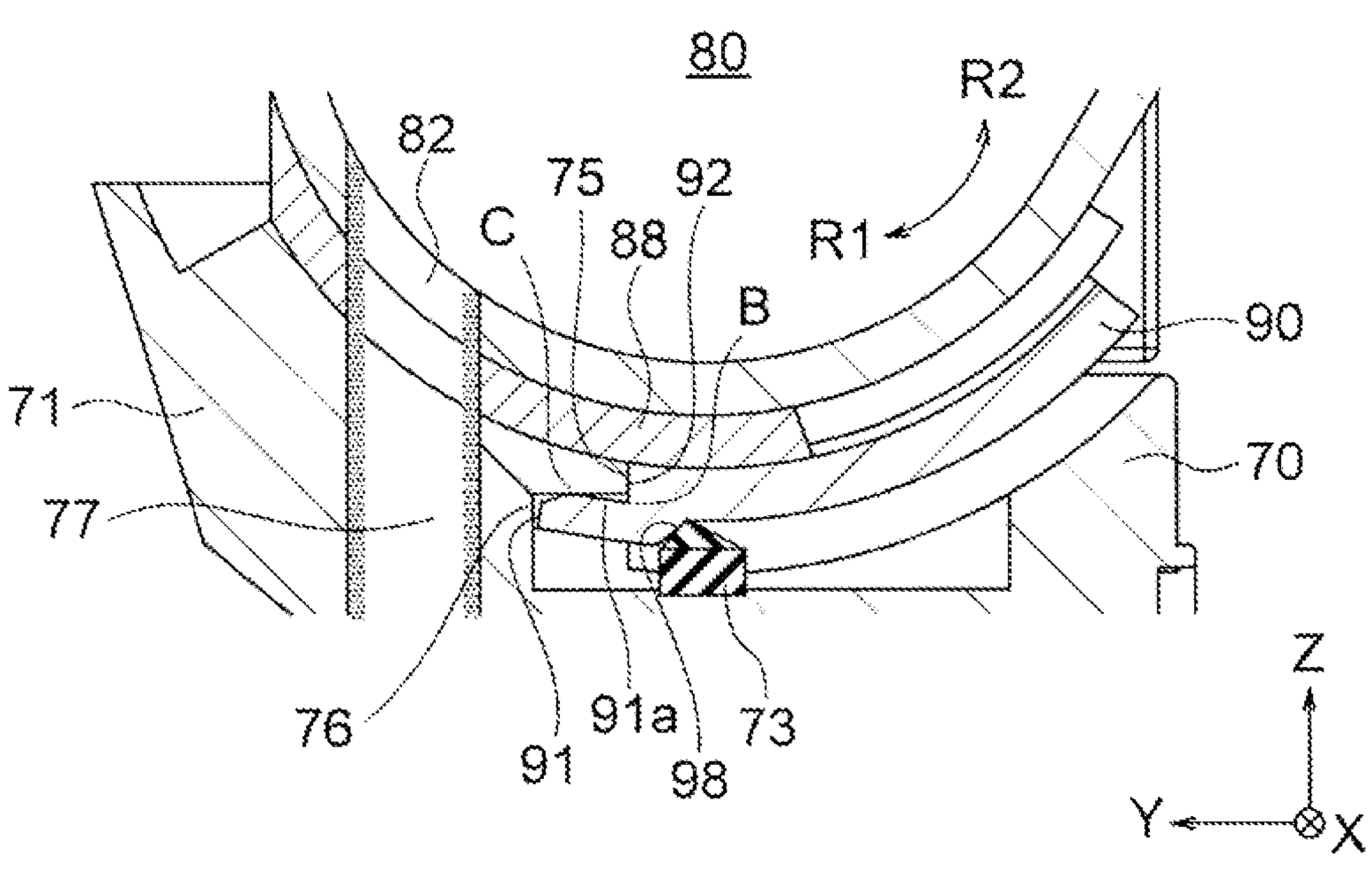

80
R2
R1
82
75
92
88
98
76a
90
71
70
77
Z
Y
X
91
91a
73
76
L1
L2

FIG. 48


80
R2
R1
82
75
92
C
88
B
90
71
70
77
Z
Y
X
76
91
91a
98
73

DEVELOPER SUPPLY DEVICE, DEVELOPMENT DEVICE, AND IMAGE FORMATION APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority based on 35 USC 119 from prior Japanese Patent Application No. 2022-027852 filed on Feb. 25, 2022, entitled "DEVELOPER SUPPLY DEVICE, DEVELOPMENT DEVICE, AND IMAGE FORMATION APPARATUS", the entire contents of which are incorporated herein by reference.

BACKGROUND

The disclosure may relate to a developer supply device configured to supply a developer, a development device and an image formation apparatus equipped with the developer supply device.

In a related art, an image formation apparatus is equipped with a developer container that contains therein a developer. The developer container includes a supply port to discharge the developer and an opening/closing member to open and close the supply port (Patent Document No. 1: Japanese Patent Application Publication No. H6-95505, see FIG. 1).

SUMMARY

However, in such a configuration, when the developer container is detached, the developer may be adhered to one end portion of the opening/closing member and spilled out. This may contaminate the surroundings of the developer container.

An object of an embodiment of the disclosure may be to provide a developer supply device that is capable of preventing a developer from spilling out of a developer container.

According to an aspect of the disclosure may be a developer supply device that may include: a developer container including a housing with a supply port, and containing a developer therein; and a developer container holder that includes a reception port to receive the developer supplied from the supply port of the developer container, and to which the developer container is to be attached in a first direction. The developer container includes: an opening/closing member movable relative to the housing between a closing position where the opening/closing member closes the supply port and an opening position where the opening/closing member opens the supply port; and a sealing member provided between the housing and the opening/closing member. The opening/closing member includes: a cover portion including a cover surface configured to close the supply port; and a protruding portion projected in the first direction from the cover portion and provided at a position spaced apart from the cover surface to a side of the developer container holder. The developer container holder includes an engagement portion configured to be engaged with the protruding portion in a state where the developer container is attached to the developer container holder. A part of the engagement portion is located between the protruding portion and the sealing member at a point after the protruding portion of the opening/closing member is engaged with the engagement portion of the developer container holder and before the supply port of the developer container and the reception port of the developer container holder are opposed to each other in a course of attaching the developer container to the developer container holder.

According to the above aspect, since the opening/closing member includes the protruding portion, the developer is caught on the protruding portion when the developer container is removed, and thus is less likely to be spilled out. In addition, since a part of the engagement portion is located between the protruding portion and the sealing member at a point after the protruding portion of the developer container is engaged with the engagement portion of the developer container holder and before the supply port of the developer container and the reception port of the developer container holder are opposed to each other, it is possible to reduce the amount of the developer adhered to the protruding portion when the developer container is removed. Therefore, it may be possible to prevent the surroundings of the developer container from becoming contaminated with the developer.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a diagram illustrating a basic configuration of an image formation apparatus according to a first embodiment;

FIG. **2** is a diagram illustrating a basic configuration of an image formation section of the image formation apparatus according to a first embodiment;

FIG. **3** is a diagram illustrating a perspective view of the image formation apparatus with a front cover being opened according to a first embodiment;

FIG. **4** is a diagram illustrating a perspective view of the developer container according to a first embodiment, viewed obliquely from above;

FIG. **5** is a diagram illustrating a perspective view of the developer container according to a first embodiment, with a portion of an outer wall removed;

FIG. **6** is a diagram illustrating a perspective view of the developer container according to a first embodiment, viewed obliquely from below;

FIG. **7** is a diagram illustrating a perspective view of the developer container according to a first embodiment with a shutter removed;

FIG. **8** is a diagram illustrating an enlarged perspective view of a supply port of the developer container and the surroundings of the supply port according to a first embodiment;

FIG. **9** is a diagram illustrating a perspective view of the shutter according to a first embodiment, viewed from above;

FIG. **10** is a diagram illustrating a perspective view of the shutter according to a first embodiment, viewed from below;

FIG. **11** is a diagram illustrating a perspective view of a holding unit according to a first embodiment;

FIG. **12** is a diagram illustrating a perspective view of the holding unit according to a first embodiment, viewed from a direction different from that of FIG. **11**;

FIGS. **13**A and **13**B are diagrams illustrating a cross sectional view and an enlarged cross sectional view of the holding unit before the developer container is mounted according to a first embodiment;

FIGS. **14**A and **14**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a first stage of an attaching operation of the developer container according to a first embodiment;

FIGS. **15**A and **15**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a second stage of the attaching operation of the developer container according to a first embodiment;

FIGS. **16**A and **16**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a third stage of the attaching operation of the developer container according to a first embodiment;

FIGS. **17**A and **17**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a fourth stage of the attaching operation of the developer container according to a first embodiment;

FIGS. **18**A and **18**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a fifth stage of the attaching operation of the developer container according to a first embodiment;

FIGS. **19**A and **19**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a sixth stage of the attaching operation of the developer container according to a first embodiment;

FIGS. **20**A and **20**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a first stage of a detaching operation of the developer container according to a first embodiment;

FIGS. **21**A and **21**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a second stage of the detaching operation of the developer container according to a first embodiment;

FIGS. **22**A and **22**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a third stage of the detaching operation of the developer container according to a first embodiment;

FIGS. **23**A and **23**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a fourth stage of the detaching operation of the developer container according to a first embodiment;

FIGS. **24**A and **24**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating a fifth stage of the detaching operation of the developer container according to a first embodiment;

FIGS. **25**A and **25**B are diagrams illustrating a cross sectional view and an enlarged cross sectional view of the holding unit after the developer container is detached according to a first embodiment;

FIGS. **26**A and **26**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating an operation of attaching a new developer container to the holding unit after a developer container is detached according to a first embodiment;

FIGS. **27**A and **27**B are diagrams of a cross sectional view and an enlarged cross sectional view illustrating an operation of attaching a new developer container to the holding unit after a developer container is detached according to a first embodiment;

FIGS. **28**A to **28**F are schematic diagrams illustrating a detaching operation of a developer container according to a comparative example;

FIG. **29** is a conceptual diagram illustrating the developer container and the holding unit according to a first embodiment;

FIG. **30** is a schematic diagram illustrating an enlarged view of an engagement section between the opening/closing member and the holding unit according to a first embodiment;

FIG. **31** is a schematic diagram illustrating an enlarged view of an engagement section between an opening/closing member and a holding unit according to a first modification;

FIGS. **32**A and **32**B are schematic diagrams illustrating a shape of a supply port of a developer container in a first embodiment and a second modification, respectively;

FIG. **33** is a diagram illustrating a basic configuration of an image formation apparatus according to a second embodiment;

FIG. **34** is a diagram illustrating a basic configuration of an image formation section of the image formation apparatus according to a second embodiment;

FIG. **35** is a diagram illustrating a perspective view of a developer container and a unit housing according to a second embodiment;

FIG. **36** is a diagram illustrating a perspective view of the developer container according to a second embodiment;

FIG. **37** is a diagram illustrating a perspective view of the developer container according to a second embodiment, viewed along a direction different from that of FIG. **36**;

FIG. **38** is a diagram of a perspective view illustrating a state in which a supply port of the developer container is opened according to a second embodiment;

FIG. **39** is a diagram illustrating a perspective view of a shutter according to a second embodiment;

FIG. **40** is a diagram illustrating a perspective view of the shutter according to a second embodiment, viewed along a direction different from that of FIG. **39**;

FIGS. **41**A and **41**B are diagrams of cross sectional views illustrating a first stage of an attaching operation of the developer container according to a second embodiment;

FIGS. **42**A and **42**B are diagrams of cross sectional views illustrating a second stage of the attaching operation of the developer container according to a second embodiment;

FIGS. **43**A and **43**B are diagrams of cross sectional views illustrating a third stage of the attaching operation of the developer container according to a second embodiment;

FIGS. **44**A and **44**B are diagrams of cross sectional views illustrating a fourth stage of the attaching operation of the developer container according to a second embodiment;

FIGS. **45**A and **45**B are diagrams of cross sectional views illustrating a fifth stage of the attaching operation of the developer container according to a second embodiment;

FIGS. **46**A, **46**B, and **46**C are diagrams of cross sectional views illustrating a detaching operation of the developer container according to a second embodiment;

FIG. **47** is a schematic diagram illustrating an engagement section between the developer container and a unit housing according to a second embodiment; and

FIG. **48** is a schematic diagram illustrating an engagement section between an opening/closing member and a unit housing according to a modification.

DETAILED DESCRIPTION

Descriptions are provided hereinbelow for one or more embodiments based on the drawings. In the respective drawings referenced herein, the same constituents are designated by the same reference numerals and duplicate explanation concerning the same constituents is omitted. All of the drawings are provided to illustrate the respective examples only.

First Embodiment

(Image Formation Apparatus)

First, an image formation apparatus according to a first embodiment is described. FIG. **1** is a diagram illustrating a view of a basic configuration of an image formation apparatus **1**. The image formation apparatus **1** may be a printer configured to form images using an electrophotographic process.

The image formation apparatus **1** includes a media feeder **120** configured to supply a medium such as print paper or the like, an image formation sections **10**K, **10**Y, **10**M, and **10**C configured to form images, a transfer unit **130** configured to transfer the images onto the medium, a fixation device **140** configured to fix the images on the media, and a media discharge section **150** configured to discharge the medium. These components are accommodated in a housing **161** of the image formation apparatus **1**. A top of the housing **161** is covered by a top cover **162**.

The media feeder **120** includes a media cassette **121**, a pickup roller **122**, a feed roller **123**, a separation pad **124**, a resist roller **125**, and a conveyance roller **127**.

The media cassette **121** accommodates therein media such as printing paper or the like. The pickup roller **122** pulls out media one by one from the media cassette **121**. The feed roller **123** and the separation pad **124** separate the media picked up by the pickup roller **122** one by one and feed the separated medium to a conveyance path **126**.

The resist roller **125** corrects a skew of the medium fed from the media cassette **121** and conveys the medium along the conveyance path **126**. The conveyance roller **127** conveys the medium being conveyed along the conveyance path **126** toward the transfer unit **130**.

The image formation sections **10**K, **10**Y, **10**M, and **10**C are sections configured to form black, yellow, magenta, and cyan developer images. The image formation sections **10**K, **10**Y, **10**M, and **10**C are arranged in a conveyance direction of the medium. Each of the image formation sections **10**K, **10**Y, **10**M, and **10**C are an example of a "development device".

The image formation sections **10**K, **10**Y, **10**M, and **10**C include image formation units **100**K, **100**Y, **100**M, and **100**C, developer containers **30**K, **30**Y, **30**M, and **30**C as developer containers, and holding units **20**K, **20**Y, **20**M, and **20**C as developer container holders or developer container holding parts to hold the developer containers, respectively.

The image formation sections **10**K, **10**Y, **10**M, and **10**C may be referred to as image formation sections **10** when there is no need to distinguish between them. The image formation units **100**K, **100**Y, **100**M, **100**C may be referred to as image formation units **100** when there is no need to distinguish between them. The developer containers **30**K, **30**Y, **30**M, and **30**C may be referred to as developer containers **30** when there is no need to distinguish between them. The holding units **20**K, **20**Y, **20**M, and **20**C may be referred to as holding units **20** when there is no need to distinguish between them.

FIG. **2** is a diagram illustrating a basic configuration of the image formation section **10**. As illustrated in FIG. **2**, the image formation section **10** as a development device includes the image formation unit **100**, the developer container **30** as the developer container and the holding unit **20** as the developer container holder (or the developer container holding part).

The image formation unit **100** includes a photosensitive drum **101** as an image carrier, a charging roller **102** as a charging member, a development roller **103** as a developer carrier, a supply roller **104** as a feeding member, a development blade **105** as a layer regulating member, and a cleaning member **106**.

The photosensitive drum **101** is a cylindrical member with a photosensitive layer formed on a surface of a conductive support. The photosensitive layer includes a stack of a charge generation layer and a charge transport layer. The photosensitive drum **101** rotates clockwise in FIG. **2**.

An exposure head **108** as an exposure device is located so as to be opposed to the photosensitive drum **101**. The exposure head **108** includes an array of LEDs (light emitting diodes) as light emitting elements and is configured to irradiate light onto the surface of the photosensitive drum **101** to form an electrostatic latent image thereon. The exposure head **108** is suspended and supported by the top cover **162** (see FIG. **1**).

The charging roller **102** is disposed to be in contact with the surface of the photosensitive drum **101** and is configured to rotate along with the rotation of the photosensitive drum **101**. The charging roller **102** is applied with a charging voltage to uniformly charge the surface of the photosensitive drum **101**.

The development roller **103** is located in contact with the surface of the photosensitive drum **101** and configured to rotate in a direction opposite to that of the photosensitive drum **101** (that is, at a contact portion between the development roller **103** and the photosensitive drum **101**, the direction in which the surface of the development roller **103** moves is the same as the direction in which the surface of the photosensitive drum **101** moves). The development roller **103** is applied with a developing voltage and configured to develop the electrostatic latent image on the surface of the photosensitive drum **101** with the developer.

The supply roller **104** is located in contact with the surface of the development roller **103** and configured to rotate in the same direction as the development roller **103** (that is, at a contact portion between the supply roller **104** and the development roller **103**, the direction in which the surface of the supply roller **104** moves is opposite to the direction in which the surface of the development roller **103** moves). The supply roller **104** is applied with a supply voltage and configured to supply the developer to the development roller **103**.

The development blade **105** is a metal blade located in contact with the development roller **103**. The development blade **105** is pressed against the surface of the development roller **103** so as to regulate a thickness of the developer layer on the surface of the development roller **103**.

The cleaning member **106** is a roller or a blade formed of an elastic material and removes off the developer remaining on the surface of the photosensitive drum **101**.

The developer container **30** is a container that contains therein the developer (indicated by the reference sign T in FIG. **2**). The developer container **30** is detachably attached to the holding unit **20** and is configured to supply the developer T to the image formation unit **100**.

The holding unit **20** is attached to the housing **161** (FIG. **1**) of the image formation apparatus **1** and holds the developer container **30** to be detachable therefrom. The developer container **30** and the holding unit **20** constitute a developer supply device **50** configured to supply the developer to the image formation unit **100**.

As illustrated in FIG. **1**, the transfer unit **130** includes transfer rollers **131** as transfer members provided so as to be opposed to the photosensitive drums **101**, a transfer belt **132** configured to pass between the photosensitive drums **101** and the transfer rollers **131**, and a drive roller **133** and a driven roller **134** between which the transfer belt **132** is stretched. The drive roller **133** is driven to rotate to run the transfer belt **132**. The driven roller **134** applies the tension to the transfer belt **132**.

The transfer rollers **131** are applied with transfer voltages. With this, the developer image formed on the surface of the

photosensitive drum **101** is transferred to the medium (indicated by the reference sign P in FIG. **2**) on the transfer belt **132** as illustrated in FIG. **2**.

The fixation device **140** is arranged on a downstream side of the image formation sections **10** in the conveyance direction of the medium. The fixation device **140** includes a fixation roller **141** and a pressure roller **142**. The fixation roller **141** includes a built-in heater, and the pressure roller **142** is pressurized to the fixation roller **141**. The fixation roller **141** and the pressure roller **142** apply heat and pressure to the medium to fix the developer image to the medium.

The media discharge section **150** includes a discharge roller pair **151** and a discharge roller pair **152** configured to convey the medium that has passed through the fixation device **140** along the conveyance path **153** and discharge the medium through a discharge port to the outside. The top cover **162** includes a stacker section **154** on which the discharged media are stacked.

In FIG. **1**, an axial direction of the photosensitive drum **101** is referred to as an X direction. The X direction is parallel to an axial direction of each roller in the image formation apparatus **1** and also is parallel to a width direction of the medium being conveyed. A movement direction of the medium as the medium passes through the image formation sections **10** is referred to as a Y direction. The direction orthogonal to the X direction and the Y direction is referred to as a Z direction. In this case, the Z direction is the vertical direction.

For the Y direction, the medium conveyance direction when the medium passes through the image formation sections **10** is referred to as a +Y direction, and the opposite direction thereto is referred to as a −Y direction. For the X direction, a right hand direction and a left hand direction as facing along the +Y direction are referred to as a +X direction and a −X direction, respectively. For the Z direction, an upper direction and a lower direction in FIG. **1** are referred to as a +Z direction and a −Z direction, respectively. Note that these X, Y, and Z directions do not limit the orientation of the image formation apparatus **1**.

(Developer Container **30** and Holding Unit **20**)

FIG. **3** is a diagram illustrating a perspective view of an exterior of the image formation apparatus **1**. The housing **161** of the Image formation apparatus **1** includes walls on both sides in the X direction and wall on both sides in the Y direction. The −X side wall of the housing **161** is provided with a front cover **163** that can be opened and closed with respect to the housing **161**. In FIG. **3**, the front cover **163** is opened.

Provided in the housing **161** are holding units **20**K, **20**Y, **20**M, and **20**K, **20**Y, **20**M, **20**C that hold the developer containers **30**K, **30**Y, **30**M, **30**C (FIG. **1**), respectively. The holding units **20**K, **20**Y, **20**M, and **20**C are all elongated in the X direction, and configured to hold the developer containers **30**K, **30**Y, **30**M, **30**C Y, **30**M, **30**C to be detachable in the X direction.

An end portion of each of the holding units **20**K, **20**Y, **20**M, and **20**C on the +X side is covered by the front cover **163**. In a state where the front cover **163** is opened, the developer container **30**K, **30** Y, **30**M, **30**C can be attached (installed) and detached (removed). The developer containers **30**K, **30**Y, **30**M, and **30**C can be attached (installed) to the holding units **20**K, **20**Y, **20**M, **20**C in the +X direction and can be detached from the holding units **20**K, **20**Y, **20**M, **20**C in the −X direction.

In the state illustrated in FIG. **3**, the developer container **30**C is the holding unit **20**C, and the developer container **30**M is being attached (installed) halfway to the holding unit **20**M. The developer containers **30**K and **30**Y have not yet been attached (installed) to the holding unit **20**K and **20**Y.

FIG. **4** is a diagram illustrating a perspective view of the developer container **30** viewed from above. As illustrated in FIG. **4**, the developer container **30** includes a housing **31** that forms an outer shell thereof. An inside of the housing **31** is a developer storage space or a developer storage portion where the developer is stored.

The housing **31** is elongated in the X direction and includes an outer wall **31***a* and a bottom **31***b*. The outer wall **31***a* has an approximately triangular shape in a cross-section thereof orthogonal to the X direction. The bottom **31***b* of the housing **31** is flat. However, the shape of the housing **31** is not limited to this shape. At an end of the outer wall **31***a* of the housing **31** on the −X side, a gripping portion **37** is formed for the user to grasp the developer container **3** when the user detaches (removes) the developer container **30**.

FIG. **5** is a diagram illustrating a perspective view of the developer container **30** with a portion of the outer wall removed. As illustrated in FIG. **5**, the bottom **31***b* of the housing **31** includes a supply port **32** through which the developer in the developer storage space is supplied to the outside of the housing **31**. In this example, the supply port **32** is formed at the center portion of the housing **31** in the X direction and closer to the end of the housing in the +Y direction. However, the position of the supply port **32** is not limited to this example. The supply port **32** is covered by a shutter **40** as an opening/closing member movable in the X direction.

A transporting member **301** and an agitating member (a stirring member) **302** are provided in the housing **31**. The transporting member **301** transports the developer toward the supply port **32**. For example, the transporting member is formed of a spiral member that rotates about a rotation axis thereof extending in the X direction. The agitating member **302** agitates the developer in the developer container **30**. For example, the agitating member **302** is formed of an agitating bar that rotates about a rotation axis thereof extending in the X direction.

At an end of the housing **31** on the +X side, a gear **303** and a gear **304** are provided that are respectively connected to the transporting member **301** and the agitating member **302**. The gears **303** and **304** receive rotational transmission from a drive gear (not illustrated) located in the image formation apparatus **1**.

In addition, a positioning post **305** is formed between the gears **303** and **304**. The positioning post **305** is a shaft member that fits into a fitting portion formed at an axis (rotation center) of the drive gear provided in the image formation apparatus **1**.

The end of the housing **31** on the +X side also includes a locating groove **39**. When the developer container **30** is mounted to a predetermined position, the positioning groove **39** is engaged with a positioning protrusion **29** (see FIG. **11**) of the holding unit **20** so as to position the developer container **30**.

FIG. **6** is a diagram illustrating a perspective view of the developer container **30** viewed from below (from the bottom **31***b* side). The bottom **31***b* of the housing **31** of the developer container **30** is formed with peripheral ribs **33** as a first insertion/extraction guide. The peripheral ribs **33** are formed on both sides of the bottom **31***b* in the Y direction and extend in the X direction. The peripheral ribs **33** function as guides when the developer container **30** is mounted on the holding unit **20**.

At the bottom **31***b* of the housing **31**, a shutter **40** that opens and closes the supply port **32** (FIG. **5**) is provided. The shutter **40** is movable in the X direction.

FIG. **7** is a diagram illustrating a perspective view of the developer container **30** illustrated in FIG. **6** with the shutter **40** removed. FIG. **8** is a diagram illustrating an enlarged perspective view of an area around the supply port **32** illustrated in FIG. **7**. As illustrated in FIG. **8**, the developer container **30** includes shutter rails **34** as first opening/closing guides elongated in the X direction and provided on both sides of the supply port **32** in the Y direction. The shutter rail **34** engages a later-described slide portion **45** (FIG. **9**) of the shutter **40**.

The developer container **30** also includes a sealing member **38** as an elastic member surrounding the supply port **32**. The sealing member **38** is made of an elastic material such as a sponge or the like and is fixed to an underside of the shutter rail **34**. The sealing member **38** extends around the supply port **32** and has a thickness in the Z direction.

The developer container **30** also includes a stopper **35** provided at an end of the shutter rail **34** on the +X side and configured to regulate the movement of the shutter **40** in the +X direction. The stopper **35** is formed of, for example, a bend portion bent toward the +Z direction from the +X side end of shutter rail **34**.

A latch **36** as a first positioning section is adjacent to and provided on the −X side of the supply port **32**. The latch **36** is provided at the bottom **31***b* of the housing **31** as a long cantilever beam extending in the X direction. An end of the latch **36** on the −X side is connected to the bottom **31***b*, and an end (a free end) of the latch **36** on the +X side is formed with a contact portion **36***a*.

FIG. **9** is a diagram illustrating a perspective view of the shutter **40** as viewed from above. FIG. **10** is a diagram illustrating a perspective view of the shutter **40** as viewed from below. As illustrated in FIG. **9**, the shutter **40** includes a cover portion **43** configured to cover (close) the supply port **32** (FIG. **5**), and a pair of side walls **44** formed on both sides of the cover portion **43** in the Y direction and extending in the X direction. An upper surface of the cover portion **43** (the surface of the cover portion **43** facing the housing **31**), i.e., the surface of the cover portion **43** facing the supply port **32** (FIG. **5**), is referred to as a cover surface **43***a*.

The side walls **44** are formed with slide portions **45** as second opening/closing guides to be engaged with the shutter rails **34** (FIG. **8**) of the housing **31**. By the engagement of the slide portions **45** with the shutter rails **34**, the shutter **40** is attached to the housing **31** so as to be movable in the X direction. Each of the side walls **44** includes two of the slide portions **45**. One of the two slide portions **45** that is located on the +X side is formed with a stopper surface **45***a* at the +X side end thereof.

In addition, one of the pair of the side walls **44** that is located in the −Y side is formed with a recess **46** in the vicinity of an end of the side wall **44** on the −X side. The recess **46** functions as a second positioning portion to be engaged with the latch **36** of the housing **31**. By the engagement between the recess **46** of the shutter **40** and the latch **36** (FIG. **8**) of the housing **31**, the shutter **40** is locked in the position that closes the supply port **32**.

At an end of the shutter **40** on the +X side, a shutter side contact portion **42** (a contact portion **42** of the shutter **40**) is formed as a first contact portion (or a first movement restriction portion). For example, the shutter side contact portion **42** is an end face orthogonal to the X direction.

The +X side end of the shutter **40** also includes a protrusion **41** as a protrusion portion. The protrusion **41** is adjacent to and provided on the −Z side of the shutter side contact portion **42** and is protruded in the +X direction further than the shutter side contact portion **42**.

The protrusion **41** includes a flat portion **41***a*, which is an upper surface of the protrusion **41** (i.e., a surface of the protrusion **41** on the side of the housing **31**), and a sloped portion **41***b*, which is inclined with respect to the flat portion **41***a*. The inclined portion **41***b* extends from the flat portion **41***a* in the +X direction. The inclined portion **41***b* is inclined so that the inclined portion **41***b* extends away from the cover surface **43***a* in the Z direction (in other words, away from the housing **31** in the Z direction) as advancing in the +X direction.

As illustrated in FIG. **10**, the shutter **40** includes an inclined portion **47** adjacent to and provided on the −X side of the protrusion **41**. Similar to the inclined portion **41***b* of the protrusion **41**, the inclined portion **47** is inclined such that the inclined portion **47** extends away from the cover surface **43***a* in the Z direction (in other words, away from the housing **31** in the Z direction) as advancing in the +X direction.

In addition, an engagement projection **48** is formed on a back surface **43***b* of the cover portion **43** opposite the cover surface **43***a* (FIG. **9**) of the cover portion **43**. The engagement projection **48** is formed in the vicinity of an end portion of the cover portion **43** on the −X side. The engagement projection **48** has an inclined surface that is inclined away from the back surface **43***b* in the Z direction (in other words, away from the housing **31** in the Z direction) as advancing in the −X direction, and an end face (vertical plane) formed at a −X side end of the inclined surface and extending in a direction orthogonal to the X direction. The engagement projection **48** functions as a portion configured to come in contact with a plate spring **23** (described later) upon attaching (installing) or detaching (removing) the developer container **30**.

FIG. **11** is a diagram illustrating a perspective view of the holding unit **20**. FIG. **12** is a diagram illustrating a perspective view of the holding unit **20** viewed from a direction different from that of FIG. **11**. As illustrated in FIGS. **11** and **12**, the holding unit **20** includes a tray **21** as a support surface on which the developer container **30** is placed. A pair of guide walls **22** as second insertion/extraction guides are provided on both sides of the tray **21** in the Y direction. The peripheral ribs **33** (see FIGS. **5-7**) of the developer container **30**) are engaged with the insides of the pair of guide walls **22**, respectively.

As illustrated in FIG. **11**, approximately at the center of the tray **21** of the holding unit **20** in the X direction, a reception port **27** (inlet port) is formed to receive the developer supplied from the supply port **32** of the developer container **30**. The reception port **27** is connected to the image formation unit **100** via a developer transfer path (a developer supply path). The supply of the developer from the reception port **27** to the image formation unit **100** can be done by drop feeding or by using some kind of conveying member.

The holding unit **20** also includes a sealing member **28** attached to the tray **21** and surrounding the reception port **27**. The sealing member **28** is formed of an elastic material such as a sponge. The sealing member **28** extends around the reception port **27** and has a thickness in the Z direction.

The holding unit **20** also includes a unit side contact portion **25** (a contact portion **25** of the holding unit **20**) serving as a second contact portion (or a second movement restriction portion) adjacent to and provided on the −X side of the reception port **27**. For example, the unit side contact portion **25** is an end face orthogonal to the X direction. The

unit side contact portion **25** is configured to come in contact with the shutter side contact portion **42** of the shutter **40** so as to restrict the movement of the shutter **40** in the +X direction.

An engagement recess **26** as an engagement portion is formed below (on the −Z side of) the unit side contact portion **25**. An inside of the recess **26** is a space into which the protrusion **41** of the shutter **40** enters.

The holding unit **20** also includes the plate spring **23** as an opening/closing anchorage part provided on the −X side of the recess **26** of the tray **21**. The plate spring **23** is an elongate member in the X direction. An end of the plate spring **23** on the +X side is fixed to the tray **21**. An end (free end) of the plate spring **23** on the −X side is formed with a protrusion (described later) protruding in the +Z direction.

In addition, an area **21***a* of the tray **21** in which the plate spring **23** is located is formed in height lower than the other areas of the tray **21** in order to secure a movement range of the protrusion **41** (FIG. **10**) of the shutter **40**.

The holding unit **20** also includes a lock release post **24**, which is a protrusion. The lock release post **24** is located adjacent to and provided on the −Y side of the plate spring **23** in the tray **21**. The lock release post **24** is configured to come in contact with the contact portion **36***a* of the latch **36** of the developer container **30***a* (FIGS. **6-8**) to bend (deform) the latch **36**, thereby disengaging the latch **36** from the recess **46** of the shutter **40**.

Note that in the state (FIG. **6**) where the latch **36** of the developer container **30** is engaged with the recess **46** of the shutter **40**, the latch **36** protrudes beyond the recess **46** in the −Y direction so that the lock release post **24** can come in contact with the latch **36**.

The holding unit **20** also includes a positioning protrusion **29** that is configured, when the developer container **30** is mounted to the predetermined position, to engaged with the positioning groove **39** of the developer container **30** (FIG. **4**). In this example, the positioning protrusion **29** is formed at an end portion of the tray **21** on the +X side.

FIG. **13**A is a diagram illustrating a cross sectional view of the holding unit **20** before the developer container **30** is attached (installed). FIG. **13**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **13**A. As described above, the unit side contact portion **25** is provided adjacent to the −X side of the reception port **27**, and the recess **26** is provided below (on the −Z side of) the unit side contact portion **25**.

An upper surface (a +Z side surface) of the recess **26** is referred to as a top surface **26***a*. The unit side contact portion **25** and the top surface **26***a* are adjacent to each other with a corner therebetween. A part of the sealing member **28** surrounding the reception port **27** is located above the top surface **26***a* (in the +Z direction).

The plate spring **23** is provided on the −X side with respect to the unit side contact portion **25** and the recess **26**. The plate spring **23** extends in the X direction and an end of the plate spring **23** on the +X side is fixed to the tray **21**.

The plate spring **23** includes, at the −X side end thereof, an inclined portion **23***a*. The inclined portion **23***a* is inclined so as to be displaced in the +Z direction as advancing in the +X direction.

The plate spring **23** includes a stopper portion **23***b* adjacent to and provided on the +X side of the inclined portion **23***a*. The stopper portion **23***b* extends approximately in the Z direction, but is slightly inclined in a direction opposite to that of the inclined portion **23***a*.

(Printing Operation of Image Formation Apparatus)

Next, a printing operation of the image formation apparatus **1** is described with reference to FIG. **1**. When a controller or a controller of the image formation apparatus **1** receives a print command and print data from a host device or an external device, the controller starts the printing operation (an image forming operation).

When the printing operation is started, the pickup roller **122** and the feed roller **123** of the media feeder **120** are driven to rotate to feed the media in the media cassette **121** one sheet at a time to the conveyance path **126**. The resist roller **125** and the conveyance roller **127** rotate to convey the medium along the conveyance path **126**.

In each of the image formation sections **10**, a charging voltage, a developing voltage and a supply voltage are applied to the charging roller **102**, the development roller **103** and the supply roller **104**, respectively. Also, in each of the image formation sections **10**, the photosensitive drum **101** rotates, and along with this, the charging roller **102**, the development roller **103**, and the supply roller **104** also rotate. The charging roller **102** uniformly charges the surface of the photosensitive drum **101**. The exposure head **108** exposes the surface of the photosensitive drum **101** with lights to thereby form an electrostatic latent image on the surface of the photosensitive drum **101**.

The electrostatic latent image formed on the surface of the photosensitive drum **101** is developed by the developer adhered to the development roller **103**, so that a developer image is formed on the surface of the photosensitive drum **101**. The developer image formed on the surface of the photosensitive drum **101** is transferred to the medium on the transfer belt **132** by the transfer voltage applied to the transfer roller **131**.

The medium having the developer images transferred thereon from the photosensitive drums of the image formation sections **10**K, **10**Y, **10**M, and **10**C is conveyed to the fixation device **140** by the transfer belt **132**.

In the fixation device **140**, the fixation roller **141** and the pressure roller **142** rotate with a fixation nip therebetween while the fixation roller **141** is heated to a predetermined fixation temperature (or a predetermined fusing temperature). When the medium passes through the fixation nip between the fixation roller **141** and the pressure roller **142**, the developer image is fixed to the medium by the heat and pressure applied from the fixation roller **141** and the pressure roller **142**.

After the developer image is fixed in the fixation device **140**, the medium is conveyed to the media discharge section **150**. In the media discharge section **150**, the medium is conveyed by the discharge roller pair **151**, **152** so as to be discharged from the discharge port to the outside. The discharged media P are stacked on the stacker **154**. This completes the printing operation.

(Attaching Operation of Developer Container **30**)

Next, an attaching operation of the developer container **30** to the holding unit **20** is described. FIG. **14**A is a diagram illustrating a cross sectional view of a first stage of the attaching operation of the developer container **30**. FIG. **14**B is an enlarged view of an area enclosed by a dashed line B in FIG. **14**A.

As illustrated in FIG. **14**A, the shutter **40** is secured (locked) to the housing **31** of the developer container **30** by the engagement between the latch **36** (FIG. **8**) of the developer container and the recess **46** (FIG. **9**) of the shutter **40** and thus is positioned at a closing position where the shutter **40** closes the supply port **32**. The developer container **30** is attached to the holding unit **20** in the +X direction while the peripheral rib **33** (FIG. **6**) of the developer

container **30** is guided by the guide walls **22** of the holding unit **20** (FIG. **11**). The +X direction is also referred to as the attaching direction (or a first direction) and is indicated by an arrow A**1** in figures.

As illustrated in FIG. **14**B, when the developer container **30** is attached, the protrusion **41** of the shutter **40** contacts the inclined portion **23***a* of the plate spring **23** of the holding unit **20**.

FIG. **15**A is a diagram illustrating a cross sectional view of a second stage of the attaching operation of the developer container **30**. FIG. **15**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **15**A. When the developer container **30** is moved further in the +X direction, the protrusion **41** of the shutter **40** presses the inclined portion **23***a* of the plate spring **23**, which causes the plate spring **23** to be deflected in the −Z direction.

FIG. **16**A is a diagram illustrating a cross sectional view of a third stage of the attaching operation of the developer container **30**. FIG. **16**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **16**A. When the developer container **30** is moved further in the +X direction, the protrusion **41** of the shutter **40** passes through the inclined portion **23***a* and the stopper portion **23***b* of the plate spring **23**. As a result, the plate spring **23** returns to the state before being bent in the −Z direction (the original state of the plate spring **23**).

FIG. **17**A is a diagram illustrating a cross sectional view of a fourth stage of the attaching operation of the developer container **30**. FIG. **17**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **17**A. When the developer container **30** is moved further in the +X direction, the inclined portion **41***b* of the protrusion **41** of the shutter **40** contacts the corner in front of the recess **26** and thus the protrusion **41** is guided into the recess **26**.

In addition, the inclined portion of the engagement projection **48** of the shutter **40** contacts the inclined portion **23***a* of the plate spring **23**, causing the plate spring **23** to be deflected in the −Z direction.

FIG. **18**A is a diagram illustrating a cross sectional view of a fifth stage in the attaching operation of the developer container **30**. FIG. **18**B is an enlarged view of an area enclosed by a dashed line B in FIG. **18**A. When the developer container **30** is moved further in the +X direction, the contact portion **42** of the shutter **40** contacts the contact portion **25** of the holding unit **20**. This restricts the movement of the shutter **40** in the +X direction.

In addition, the protrusion **41** of the shutter **40** enters into the recess **26** of the holding unit **20**, and the flat portion **41***a* of the protrusion **41** contacts the top surface **26***a* of the recess **26**. In addition, the engagement projection **48** of the shutter **40** passes through the inclined portion **23***a* and the stopper portion **23***b* of the plate spring **23**. As a result, the plate spring **23** returns to the state before being deflected in the −Z direction (the original state of the plate spring **23**).

Furthermore, the lock release post **24** (FIG. **11**) of the holding unit **20** contacts the contact portion **36***a* (FIG. **8**) of the latch **36** of the developer container **30**, causing the latch **36** to be deflected. This disengages the latch **36** of the developer container **30** and the recess **46** (FIG. **9**) of the shutter **40**, allowing the shutter **40** can move in the X direction with respect to the developer container **30**.

FIG. **19**A is a diagram illustrating a cross sectional view of a sixth stage in the attaching operation of the developer container **30**. FIG. **19**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **19**A. At this sixth stage, the movement of the shutter **40** in the +X direction is restricted by the contact between the shutter side contact portion **42** and the unit side contact portion **25**. Therefore, when the developer container **30** is moved further in the +X direction with respect to the holding unit **20**, the housing **31** of the developer container **30** moves in the +X direction leaving the shutter **40**. In other words, the shutter **40** is moved relative to the housing **31** of the developer container **30** in the −X direction, so as to open the supply port **32** of the developer container **30**.

When the developer container **30** reaches the limit of the movement in the +X direction (i.e., an installed position or an attachment position), the positioning groove **39** (FIG. **5**) of the developer container **30** is engaged with the positioning protrusion **29** (FIG. **11**) of the holding unit **20**, and thus the developer container **30** is positioned with respect to the holding unit **20**. In addition, the positioning post **305** (FIG. **5**) of the developer container **30** is engaged with a fitting hole of the drive gear (not illustrated) provided in the image formation apparatus **1**, and the drive gear of the image formation apparatus is engaged with the gears **303** and **304** (FIG. **5**) of the developer container **30**.

In this state, the shutter **40** completely opens the supply port **32**, and thus the supply port **32** of the developer container **30** and the reception port **27** of the holding unit **20** are connected to each other. As a result, the developer in the developer container **30** can be supplied from the supply port **32** to the reception port **27**.

In addition, the gears **303** and **304** (FIG. **5**) of the developer container **30** are rotated by the gear in the image formation apparatus **1**, causing the transporting member **301** and the agitating member **302** to rotate. With this, the developer in the developer container **30** is transported toward the supply port **32** in the developer container **30** with being agitated and then is supplied from the supply port **32** to the reception port **27**. The developer transported to the reception port **27** is supplied to the image formation unit **100** (FIG. **2**). In other words, the image formation apparatus **1** becomes ready for performing a printing operation with the developer.

(Detaching Operation of Developer Container **30**)

Next, a detaching operation of the developer container **30** that is used up from the holding unit **20** is described. FIG. **20**A is a diagram illustrating a cross sectional view of a first stage of the detaching operation of the developer container **30**. FIG. **20**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **20**A.

In a state where the developer container **30** is used up, i.e., when all the developer in the developer container **30** has been discharged, the developer is adhered to the inner wall surface of each of the reception port **27**, the sealing member **38**, and the supply port **32**, as illustrated by the reference sign T**1** in FIG. **20**B.

From the state (the installed position) illustrated in FIGS. **20**A and **20**B, the user tries to detach (remove) the developer container **30** in the −X direction. Note that the −X direction is also referred to as a detaching direction (or a second direction) and is indicated by an arrow A**2** in the figures.

At this state illustrated in FIGS. **20**A and **20**B, by the contact between the engagement projection **48** of the shutter **40** and the stopper portion **23***b* of the plate spring **23** of the holding unit **20**, the movement of the shutter **40** in the −X direction is restricted. Therefore, when the developer container **30** is pulled out in the −X direction, the housing **31** of the developer container **30** moves in the −X direction, leaving the shutter **40**. In other words, the shutter **40** moves in the +X direction relative to the housing **31** of the developer container **30**.

FIG. **21**A is a diagram illustrating a cross sectional view of a second stage of the detaching operation of the developer container **30**. FIG. **21**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **21**A. When the developer container **30** is moved in the −X direction from the state illustrated in FIGS. **20**A and **20**B, the inner wall surface of the supply port **32** on the −X side passes through the shutter side contact portion **42**, as illustrated in FIGS. **21**A and **21**B. At this time, the developer that is adhered to the inner wall of the supply port **32** is scraped off by the shutter side contact portion **42** and thus is adhered to the shutter side contact portion **42** as illustrated by the reference sign T**2** in the figures.

FIG. **22**A is a diagram illustrating a cross sectional view of a third stage of the detaching operation of the developer container **30**. FIG. **22**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **22**A. When the developer container **30** is further moved in the −X direction, the shutter **40** reaches the closing position where the shutter **40** closes the supply port **32**. When the shutter **40** reaches the closing position as illustrated in FIGS. **20**A and **20**B, the shutter side contact portion **42** has scraped off the developer from the inner wall surfaces of the −X side and the +X side of the supply port **32**. Thus, the developer is adhered to the shutter side contact portion **42** as illustrated by the reference sign T**2**.

When the shutter **40** reaches the closing position, the latch **36** (FIG. **8**) of the developer container **30** is engaged with the recess **46** (FIG. **9**) of the shutter **40**, and the stopper **35** (FIG. **8**) of the developer container **30** and the stopper surface **45***a* (FIG. **9**) of the shutter **40** are in contact with each other. This regulates the movement of the shutter **40** relative to the housing **31** of the developer container **30**. In other words, the shutter **40** moves integrally with the housing **31** of the developer container **30**.

In addition, the engagement projection **48** of the shutter **40** is in contact with the stopper portion **23***b* of the plate spring **23**. However, since the force F**1** applied by the user to pull the developer container **30** exceeds the maximum value of the resistance force F**2** that the engagement projection **48** receives from the plate spring **23** (F**1**>F**2**), the plate spring **23** is deflected in the −Z direction as explained below.

FIG. **23**A is a diagram illustrating a cross sectional view of a fourth stage of the detaching operation of the developer container **30**. FIG. **23**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **23**A. When the developer container **30** is moved further in the −X direction, the shutter **40** moves integrally with the housing **31** of the developer container **30** in the −X direction, and the plate spring **23** of the holding unit **20** is pressed by the engagement projection **48** of the shutter **40**, which causes the plate spring **23** to be deflected in the −Z direction. With this, the developer container **30** can be further moved in the −X direction.

When the developer container **30** moves further in the −X direction, the shutter side contact portion **42** of the shutter **40** is moved away from the unit side contact portion **25** of the holding unit **20** in the −X direction, and thus the protrusion **41** of the shutter **40** comes out of the recess **26** of the holding unit **20** in the −X direction. At this time, a part of the developer T**2** that was adhered to the shutter side contact portion **42** falls and is then adhered onto the flat portion **41***a* of the protrusion **41** as illustrated by the reference sign T**3**.

FIG. **24**A is a diagram illustrating a cross sectional view of a fifth step in the detaching operation of the developer container **30**. FIG. **24**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **24**A. When the developer container **30** is further moved in the −X direction, the developer container **30** is removed from the holding unit **20** with the developer T**2** being adhered to the shutter side contact portion **42** and the developer T**3** being adhered to the flat portion **41***a* of the protrusion **41**.

Note that when the developer container **30** is further moved in the −X direction from the state illustrated in FIGS. **24**A and **24**B, the inclined portion **47** of the shutter **40** comes in contact with the stopper portion **23***b* of the plate spring **23**, causing the plate spring **23** to be deflected in the −Z direction, so that the developer container **30** can be removed out of the holding unit **20** in the −X direction.

In the state where the developer container **30** is removed out of the holding unit **20**, the developer T**2** keeps being adhered to the shutter side contact portion **42** and the developer T**3** keeps being adhered to the flat portion **41***a* of the protrusion **41**. With this, the area around the developer container **30** is prevented from becoming contaminated with the developer.

(Attaching Operation of New Developer Container **30**)

Next, an operation of attaching a new developer container **30** to the holding unit **20** from which at least one used developer container **30** has been removed is described.

FIG. **25**A is a cross sectional view of the holding unit **20** after the used developer container **30** has been removed. FIG. **25**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **25**A.

After the used developer container **30** is removed, the developer T**4** is adhered to the area around the reception port **27** of the holding unit **20** (e.g., the area on the sealing member **28**). This developer T**4** is the developer that has fallen from the inner wall of the supply port **32** of the developer container **30** when the developer container **30** is removed.

FIG. **26**A illustrates a cross sectional view of the attachment operation of the developer container **30** to the holding unit **20**. FIG. **26**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **26**A. The attaching operation (the installation operation) of the developer container **30** is performed as described in FIGS. **14**A through **18**B.

By the movement of the developer container **30** in the +X direction, the protrusion **41** of the shutter **40** enters into the recess **26** of the holding unit **20** and the shutter side contact portion **42** of the shutter **40** comes in contact with the unit side contact portion **25** of the holding unit **20**.

At this time, since the flat portion **41***a* of the protrusion **41** contacts the top surface **26***a* of the recess **26**, so that the sealing member **38** passes over the holding unit **20** (e.g., over the sealing member **28**) in a state where the sealing member **38** is pressed between the developer container **30** and the holding unit **20**. Therefore, the developer T**4** remaining on the holding unit **20** is pushed by the sealing member **38** of the developer container **30** and is thus moved in the +X direction.

FIG. **27**A is a diagram illustrating a cross sectional view of a state where the developer container **30** is further moved in the +X direction. FIG. **27**B is a diagram illustrating an enlarged view of an area enclosed by a dashed line B in FIG. **27**A. As described above, since the sealing member **38** of the developer container **30** passes over the holding unit **20** in the pressed state, the developer T**4** remaining on the holding unit **20** is pressed by the sealing member **38** and falls into the reception port **27** as illustrated by the arrow G. With this, the area around the reception port **27** of the holding unit **20** is cleaned by the sealing member **38**.

(Actions)

Next, actions of a first embodiment are described. First, a comparative example to be compared with a first embodiment is described. FIGS. **28**A to **28**F are schematic diagrams illustrating a detaching operation of a developer container **30** in the comparative example. As illustrated in FIG. **28**A, the developer container **30** according to the comparative example differs from the developer container **30** according to a first embodiment in that the developer container **30** according to the comparative example does not include the protrusion **41** at the end portion **40***a* of the shutter **40** on the +X side.

As illustrated in FIG. **28**B, in a state where the supply of the developer T from the developer container **30** to the holding unit **20** is completed, some of the developer (indicated by the reference sign T**1**) is adhered to the inner wall surfaces of the supply port **32** of the developer container **30** and the reception port **27** of the holding unit **20**.

As illustrated in FIG. **28**C, when the developer container **30** of the comparative example is moved in the −X direction, the −X side inner wall surface of the supply port **32** of the developer container **30** passes through the +X side end portion **40***a* of the shutter **40** while some of the developer T**1** that is adhered to the −X side inner wall surface is being scraped off.

As illustrated in FIG. **28**D, when the developer container **30** is further moved in the −X direction, the +X side inner wall surface of the supply port **32** of the developer container **30** passes through the +X side end portion **40***a* of the shutter **40** while some of the developer T**1** that is adhered to the +X side inner wall surface is being scraped off.

As illustrated in FIG. **28**E, the developer container **30** is then removed in the −X direction in a state where the developer (indicated by the reference sign T**5**) that has been fallen from the inner wall surfaces of the supply port **32** is adhered to the +X side end portion **40***a* of the shutter **40**.

As illustrated in FIG. **28**F, in a state where the developer container **30** is removed from the holding unit **20**, the developer T**5** is adhered to the end portion **40***a* of the shutter **40**. As a result, the developer T**5** may spill out from the end portion **40***a* of the shutter **40** and may contaminate the surroundings of the developer container **30** (e.g., on a desk on which the developer container **30** is placed).

FIG. **29** is a conceptual diagram schematically illustrating the developer container **30** and the holding unit **20** according to a first embodiment. In a first embodiment, the shutter **40** of the developer container **30** includes the shutter side contact portion **42** at the end portion thereof in the +X direction (i.e., in the direction of attaching (installing) the developer container **30**) and the protrusion **41** on the lower side of the shutter side contact portion **42** (i.e., the side opposite to the housing **31** with respect to the shutter side contact portion **42**). In the state where the developer container **30** is installed to the holding unit **20**, the protrusion **41** of the shutter **40** enters into the recess **26** of the holding unit **20**.

Therefore, the developers T**2** and T**3** that were scraped off from the inner wall surfaces of the supply port **32** of the developer container **30** or the like during the detaching operation of the developer container **30** described with reference to FIGS. **20**A to **24**B are held on the protrusion **41** of the shutter **40**, as illustrated in FIG. **24**B.

Therefore, even after the developer container **30** is removed from the holding unit **20**, the protrusion **41** of the shutter **40** holds the developer, preventing the developer from spilling out of the developer container **30**. With this, the surroundings of the removed developer container **30** are prevented from becoming contaminated with the developer.

Further, as illustrated in FIG. **19**B, in the state where the developer container **30** is installed to the holding unit **20**, the protrusion **41** of the shutter **40** enters in the recess **26** of the holding unit **20**, with no gap being created on the protrusion **41**. This reduces the amount of developer that is adhered onto the protrusion **41** when the developer container **30** is removed.

As schematically illustrated in FIG. **29**, it may be preferable that the distance L in the Z direction between the cover surface **43***a* of the cover portion **43** of the shutter **40** and the flat portion **41***a* of the protrusion **41** be 5 mm or less. The reason is that it is difficult to put the user's fingers into the gap between the developer container **30** and the protrusion **41** of the shutter **40**, if the distance L is 5 mm or less.

FIG. **30** is a schematic diagram illustrating the protrusion **41** and the shutter side contact portion **42** of the shutter **40** and the holding unit side contact portion **25** and the recess **26** of the holding unit **20**. As illustrated in FIG. **30**, when the protrusion **41** of the shutter **40** is engaged with the recess **26** of the holding unit **20**, the flat portion **41***a* of the protrusion **41** contacts the top surface **26***a* of the recess **26**.

Therefore, the distance between the housing **31** of the developer container **30** and the holding unit **20** is kept constant. As a result, as illustrated in FIGS. **26**B to **27**B described above, the sealing member **38** passes over the holding unit **20** with the sealing member **38** being pressed between the housing **31** of the developer container **30** and the holding unit **20**. Therefore, the developer T**4** (FIG. **27**B) remaining on the holding unit **20** can be efficiently removed.

The distance L**2** by which the recess **26** is recessed in the +X direction from the unit side contact portion **25** is longer than the distance L**1** by which the protrusion **41** protrudes in the +X direction from the shutter side contact portion **42**. Therefore, with the shutter side contact portion **42** and the unit side contact portion **25** in contact without any gap, the protrusion **41** of the shutter **40** and the recess **26** of the holding unit **20** can be engaged with each other.

Note that it may be preferable that an inclined portion **26***b* (second inclined portion), which corresponds to the inclined portion **41***b* (first inclined portion) of the protrusion **41**, is formed between the unit side contact portion **25** of the holding unit **20** and the top surface **26***a* of the recess **26**. With this configuration, when the protrusion **41** of the shutter **40** enters in the recess **26** of the holding unit **20**, the inclined portion **41***b* of the protrusion **41** comes in contact with the inclined portion **26***b* of the holding unit **20**.

The housing **31** of the developer container **30** is pressurized in the +Z direction by the pressure of the sealing member (elastic member) **38**, and thus the shutter **40** is also pressurized in the +Z direction through the engagement of the shutter rails **34** and the slide portions **45**. As attaching (installing) the developer container **30** to the holding unit **20**, the shutter **40** is guided in the −Z direction, by the contact between the inclined portion **41***b* of the protrusion **41** and the inclined portion **26***b* of the holding unit **20**. In other words, the developer container **30** is guided in the −Z direction so that the distance between the holding unit **20** and the housing **31** of the developer container **30**, which is pressurized in the +Z direction by the pressing force of the sealing member **38**, becomes a predetermined distance.

As a result, the sealing member **38** between the portion **201** of the holding unit **20** and the housing **31** is compressed and thus the thickness D**1** of the sealing member **38** in the Z direction is reduced. As a result, the effects of the sealing

member **38** in cleaning the area surrounding the reception port **27** of the holding unit **20** can be enhanced.

(Effects of First Embodiment)

As explained above, the developer supply device **50** according to a first embodiment includes the developer container **30** and the holding unit **20** (the developer container holder). The developer container **30** includes the shutter **40** (the opening/closing member) configured to open and close the supply port **32** of the housing **31** and the sealing member **38** provided between the housing **31** and the shutter **40**. The shutter **40** includes the cover portion **43** including the cover surface **43***a* configured to close the supply port **32** of the developer container **30** and the protrusion **41** (the protruding portion) protruding from the cover portion **43** in the +X direction (the attaching direction of the developer container **30**). The protrusion **41** is provided at the position spaced away from the cover surface **43***a* to the holding unit **20** side. The holding unit **20** includes the recess **26** (the engagement portion) that is configured to be engaged with the protrusion **41** of the shutter **40** in the state where the developer container **30** is installed (attached) to the holding unit **20**.

Since the shutter **40** includes the protrusion **41**, the developer that falls from the inner wall of the supply port **32** during the removal of the developer container **30** from the holding unit **20** is retained by the protrusion **41** of the shutter **40**. This prevents the developer from spilling out of the developer container **30** after the removal. As a result, the surroundings of the developer container **30** can be prevented from becoming contaminated with the developer.

Further in a first embodiment, from a certain point after the protrusion **41** and the recess **26** are engaged until the supply port **32** and the reception port **27** are opposed (aligned) to each other in the course of attaching the developer container **30** to the holding unit **20**, a part of the recess **26** (the top surface **26***a* of the recess **26**) is located between the protrusion **41** and the sealing member **38**. Therefore, the amount of the developer that is adhered onto the protrusion **41** when the developer container **30** is removed can be reduced.

Further in a first embodiment, in the state where the protrusion **41** of the shutter **40** is engaged with the recess **26** of the holding unit **20**, the developer container **30** is moved up to the installed position (i.e., the position where the supply port **32** and the reception port **27** are communicated with each other) to open the supply port **32** by the shutter **40**. Therefore, the shutter **40** is opened only when the supply port **32** and the reception port **27** are opposed to each other, which reliably prevents leakage of the developer.

(First Modification)

Next, a first modification of a first embodiment is described. FIG. **31** is a diagram illustrating an enlarged view of an engagement section between the shutter **40** and the holding unit **20** in a first modification. In FIG. **31**, the +X direction (the first direction) is indicated by an arrow A**1**, the −X direction (the second direction) is indicated by an arrow A**2**, the developer container **30** side is indicated by an arrow B**1**, and the holding unit **20** side is indicated by an arrow B**2**.

In the shutter **40** according to a first embodiment, the entire top surface of the protrusion **41** is the flat portion **41***a*, and the flat portion **41***a* is configured to come in contact with the top surface **26***a* of the recess **26** of the holding unit **20**, as illustrated in FIG. **30**.

To the contrary, in a first modification, as illustrated in FIG. **31**, the protrusion **41** is formed with a hole **41***c* on a surface of the protrusion **41** on the +Z side (on the developer container **30** side), such that the hole **41***c* is provided on the −X side (the side of the second direction) with respect to the flat portion **41***a* of the protrusion **41**. That is, the protrusion **41** is protruded in the +X direction (the first direction indicated by the arrow A**1**) from the shutter side contact portion **42**, and the surface of the protrusion **41** on the developer container **30** side (the arrow B**1** side) is formed with the hole **41***c* provided on the −X direction side (the second direction side: the arrow A**2** side) with respect to the flat portion **41***a* of the protrusion **41**. In other words, the hole **41***c* is formed between the flat portion **41***a* of the protrusion **41** (the contact portion of the protrusion **41** that contacts the top surface **26***a* of the recess **26**) and the shutter side contact portion **42**.

With this configuration, when the protrusion **41** is pulled out of the recess **26** as illustrated in FIGS. **22**B to **23**B, the developer that drops on the protrusion **41** is retained in the hole **41***c*. In addition, since the developer is retained in the hole **41***c* even after the developer container **30** is removed from the holding unit **20**, it may be difficult for the developer to be scattered even if the removed developer container **30** receives a shock. As a result, the effect of preventing the surroundings of the developer container **30** from becoming contaminated with developer can be enhanced.

In a first modification, the hole **41***c* is provided on the −X side with respect to the flat portion **41***a* of the protrusion **41**. However, the disclosure is not limited thereto. For example, the flat portion **41***a* may be formed to be inclined such that the flat portion **41***a* is displaced in the −Z direction as advancing in the −X direction. In such a case, an area including the lowest point of the flat portion **41***a* functions as a hole.

(Second Modification)

Next, a second modification of a first embodiment is described. FIG. **32**A is a diagram illustrating an enlarged view of the supply port **32** of the developer container **30** and the area in the vicinity of the supply port **32** according to a first embodiment. FIG. **32**B is a diagram illustrating an enlarged view of the supply port **32** of the developer container **30** and the area in the vicinity of the supply port **32** according to a second modification.

In a first embodiment, as illustrated in FIG. **32**A, the inner wall surface **32***a* of the supply port **32** is parallel to the Z direction, and the internal dimension W**1** of the upper end (the +Z side end) of the supply port **32** and the internal dimension W**2** of the lower end (the −Z side end) of the supply port **32** are equal (W**1**=W**2**).

To the contrary, in a second modification, as illustrated in FIG. **32**B, the inner wall surface **32***a* of the supply port **32** is inclined with respect to the Z direction, and the internal dimension W**4** of the lower end of the supply port **32** is larger than the internal dimension W**3** of the upper end of the supply port **32** (W**3**<W**4**).

With this configuration, when the developer is supplied (discharged) from the developer container **30**, it is less likely that the developer is adhered to the inner wall surface **32***a* (especially, the lower area of the inner wall surface **32***a*) of the supply port **32**. Therefore, the amount of the developer that is adhered to the shutter side contact portion **42** when the used developer container **30** is removed is reduced. As a result, the effect of preventing the surroundings of the developer container **30** from becoming contaminated with developer can be further enhanced.

Second Embodiment

Next, a second embodiment is described. FIG. **33** is a diagram illustrating a basic configuration of an image for-

mation apparatus **1**A according to a second embodiment. The image formation apparatus **1**A according to a second embodiment has a same configuration as the image formation apparatus **1** according to a first embodiment (FIG. **1**) except for image formation sections **11**K, **11**Y, **11**M, and **11**C.

The image formation sections **11**K, **11**Y, **11**M, and **11**C according to a second embodiment respectively includes image formation units **110**K, **110**Y, **110**M, and **110**C and developer containers **80**K, **80**Y, **80**M, and **80**C as developer containers.

The image formation sections **11**K, **11**Y, **11**M, and **11**C may be referred to as image formation sections **11** when there is no need to distinguish between them. The image formation units **110**K, **110**Y, **110**M, and **110**C may be referred to as image formation units **110** when there is no need to distinguish between them. The developer containers **80**K, **80**Y, **80**M, and **80**C may be referred to as developer containers **80** when there is no need to distinguish between them.

FIG. **34** is a diagram illustrating a view of a basic configuration of the image formation section **11**. As illustrated in FIG. **34**, each image formation section **11** includes the image formation unit **110** and the developer container **80** as the developer container. The developer container **80** is detachably attached to the image formation unit **110**. In a second embodiment, the holding unit **20** (FIG. **2**) described in a first embodiment is not provided.

As in the image formation unit **100** according to a first embodiment, the image formation unit **110** according to a second embodiment includes the photosensitive drum **101**, the charging roller **102**, the development roller **103**, the supply roller **104**, the development blade **105**, and the cleaning member **106**. The configurations of these components are as described in a first embodiment.

The image formation unit **110** includes a unit housing **70** (a housing **70** of the image formation unit) serving as a developer container holder. The developer container **80** is detachably attached to the unit housing **70**. The developer container **80** and the unit housing **70** constitute a developer supply device **60** configured to supply the developer to the image formation unit **110**.

FIG. **35** is a diagram illustrating a perspective view of the developer container **80** and the unit housing **70**. FIG. **36** is a diagram illustrating a perspective view of the developer container **80**. FIG. **37** is a diagram illustrating a perspective view of the developer container **80** viewed from a different angle than that of FIG. **36**. FIG. **38** is a diagram illustrating a perspective view of the developer container **80** with a supply port **82** (described later) opened.

In the following description, the clockwise direction when viewing in the +X direction is referred to as an R**1** direction and the counterclockwise direction when viewing in the +X direction is referred to as an R**2** direction. As described below, the developer container **80** is installed to the installed position on the unit housing **70** by rotating the developer container **80** in the R**1** direction, while the developer container **80** is removed from the installed position by rotating the developer container **80** in the R**2** direction (see FIG. **44**A to FIG. **45**B).

Thus, the R**1** direction is also referred to as the attaching direction of the developer container **30** (or a first direction) and the R**2** direction as the removal direction of the developer container **30** (or a second direction). Note that upon opening and closing the supply port **82**, a housing **81** of the developer container **80** is rotated while a shutter **90** is kept still.

As illustrated in FIGS. **35** and **36**, the developer container **80** includes the housing **81** that forms an outer shell thereof. The housing **81** is elongate in the X direction and includes an outer wall **81***a* and a bottom **81***b*. The outer wall **81***a* has a rectangular shape in a cross-section orthogonal to the X direction, and the bottom **81***b* has an abbreviated semi-cylindrical shape in the cross-section orthogonal to the X direction. However, the shape of the housing **81** is not limited thereto.

An inside of the housing **81** is a developer storage space or a developer storage portion where the developer is stored. In the housing **81**, an agitating member **801** (FIG. **41**B) configured to agitate the developer is provided. At an end of the housing **81** on the −X side, a gear **802** connected to the agitating member (a stirring member) **801** is provided.

An end of the outer wall **81***a* of the housing **81** on the −X side also includes a lock groove **83** as a first insertion/extraction guide. When attaching the developer container **80** to the unit housing **70**, a guide rib **72***a* (described later) of the unit housing **70** is inserted into the lock groove **83**.

The lock groove **83** includes an opening **83***a* through which the guide rib **72***a* is to be inserted in the Z direction. The lock groove **83** also includes an arc-shaped lock portion **83***b* configured to be engaged with the guide rib **72***a* (that is inserted in the lock groove **83** through the opening **83***a*) when the developer container **80** (the lock groove **83**) is rotated, and a stopper portion **83***c* configured to contact with the guide rib **72***a* in the rotation direction.

The bottom **81***b* of the housing **81** is formed with the supply port **82** (FIG. **38**). A sealing member **88** (FIG. **38**), formed of an elastic material such as sponge, is attached to the bottom **81***b* of the housing **81** to surround the supply port **82**.

The developer container **80** includes the shutter **90** as an opening/closing member configured to open and close the supply port **82** of the housing **81**. The bottom **81***b* of the housing **81** includes a pair of shutter rails **84** that guide the shutter **90** in the rotational direction about a virtual axis in the X direction. The shutter **90** is configured to rotate with being guided by the shutter rails **84**, so as to open the supply port **82** in an opening position illustrated in FIG. **38** and close the supply port **82** in a closing position illustrated in FIG. **37**.

At an end of each shutter rail **84** in the R**1** direction, a stopper **85** (FIG. **38**) is formed to restrict the movement of the shutter **90** in the R**1** direction relative to the shutter rail **84**. The stopper **85** is, for example, a bend portion that bends radially inward from the R**1** side end of the shutter rail **84**.

The housing **81** of the developer container **80** is formed with a latch **86** as a first positioning portion adjacent to the −X side shutter rail **84** of the two shutter rails **84**. The latch **86** is formed in an area **81***c* that is recessed one step lower from the surface of the bottom **81***b* of the housing **81**.

The latch **86** is formed as a cantilever elongated in the rotation direction of the shutter **90**. An end of the latch **86** in the R**2** direction is connected to the housing **81**, and an end (free end) of the latch **86** in the R**1** direction includes a contact portion **86***a* (FIG. **38**).

FIG. **39** is a diagram illustrating a perspective view of the shutter **90**. FIG. **40** is a diagram illustrating a perspective view of the shutter **90** viewed from a direction different from that of FIG. **39**. As illustrated in FIG. **39**, the shutter **90** includes a cover portion **93** configured to cover (close) the supply port **82**. The cover portion **93** includes a cover surface **93***a* facing the supply port **82**. The cover surface **93***a* is a part of a cylindrical surface.

As illustrated in FIG. **40**, at both ends of the cover portion **93** in the X direction, slide portions **95** (FIG. **40**) are provided as second opening/closing guides that are to be engaged with the shutter rails **84** of the housing **81**. Each of both ends of the cover portion **93** in the X direction includes two slide portions **95**. One of the two slide portions **95** on the R**1** side direction includes, at the R**1** side end thereof, a stopper surface **95***a*.

The end of the shutter **90** on the −X side includes a projection **96** as a second positioning portion, which is configured to be engaged with the latch **86** of the housing **81** (FIG. **35**). When the projection **96** of the shutter **90** is engaged with the latch **86** of the housing **81**, the engagement causes the shutter **90** to be locked in a closing position where the shutter **90** closes the supply port **82**.

At the end of the shutter **90** in the R**1** side, a shutter side contact portion **92** is formed as a first contact portion (or a first movement restriction portion). The shutter side contact portion **92** is, for example, an end face orthogonal to the R**1** direction.

At the end of the shutter **90** in the R**1** side, a protrusion **91** is also formed. The protrusion **91** is formed on the opposite side of the housing **81** with respect to the shutter side contact portion **92** and is protruded in the R**1** direction further than the shutter side contact portion **92**. The protrusion **91** includes a flat portion **91***a*, which is a surface of the protrusion on the side of the housing **81** and an inclined portion **91***b* that is inclined with respect to the flat portion **91***a*. The inclined portion **91***b* is located on the R**1** side relative to the flat portion **91***a*. The inclined portion **91***b* is inclined such that the inclined portion **91***b* is displaced away from a virtual cylindrical plane including the cover surface **93***a* as advancing in the R**1** direction.

As illustrated in FIG. **39**, a back surface **93***b* of the shutter **90**, which is an opposite side of the cover surface **93***a* of the shutter **90**, includes an inclined portion **98** adjacent to and provided on the R**2** side of the protrusion **91**. The inclined portion **98** is inclined such that the inclined portion **98** is displaced closer to a virtual cylindrical plane including the back surface **93***b* as advancing in the R**2** direction. The inclined portion **98** is configured to be in contact with an elastic anchorage part **73** (described later) in a state where the developer container **80** is installed to the unit housing **70**.

As illustrated in FIG. **35**, the unit housing **70** includes a tray **71** serving as a support surface on which the developer container **80** is placed. The tray **71** is a part of a cylindrical plane centered on a virtual axis extending in the X direction. On the tray **71**, the developer container **80** is rotatably supported.

A pair of walls **72** are provided on both sides of the tray **71** in the X direction. Each wall **72** is formed with a guide rib **72***a* as a second insertion/extraction guide, which is configured to be engaged with the lock groove **83** of the developer container **80**.

At an approximately center of the tray **71** of the unit housing **70** in the X direction, a reception port **77** is formed to receive the developer supplied from the developer container **80**. The developer received through the reception port **77** is supplied to the image formation unit **110**. A sealing member may be placed to surround the reception port **77**.

The unit housing **70** also includes a unit side contact portion **75** (a contact portion **75** of the unit housing **70**) serving as a second contact portion (or a second movement restriction portion) adjacent to and provided on the R**2** side of the reception port **77**. The unit side contact portion **75** is configured to come in contact with a shutter side contact portion **92** (described later) of the shutter **90**, so as to restrict the rotation of the shutter **90**. The unit side contact portion **75** is, for example, an end face orthogonal to the rotation direction of the developer container **80**.

An engagement recess **76** as an engagement portion is formed below (on the −Z side of) the unit side contact portion **75**. An inside of the recess **76** is a space into which the protrusion **91** of the shutter **90** enters. The elastic anchorage part **73** (FIG. **41**B) serving as an opening/closing anchorage part is adjacent to and provided on the R**2** side of the recess **76** of the tray **71**. The elastic anchorage part **73** is discussed later.

The unit housing **70** also includes a lock release post **74**. The lock release post **74** contacts the contact portion **86***a* of the latch **86** of the developer container **80**, causing the latch **86** to be deflected, thereby releasing the engagement between the latch **86** and the projection **96** of the shutter **90**.

(Attaching Operation of Developer Container **80**)

Next, an operation of attaching the developer container **80** to the unit housing **70** is described. FIGS. **41**A and **41**B are diagrams illustrating a first stage of the attaching operation of the developer container **80**. FIG. **41**A illustrates the end of the developer container **80** in the X direction, and FIG. **41**B illustrates the central area of the developer container **80** in the X direction, i.e., the area including the supply port **82**.

As illustrated in FIG. **41**A, the developer container **80** is placed away from the unit housing **70** in the +Z direction, in order to move the developer container **80** toward the unit housing **70** in the −Z direction so as to place the developer container **80** onto the unit housing **70**. In the state illustrated in FIG. **41**B, by the engagement between the latch **86** (FIG. **35**) of the developer container **80** and the projection **96** of the shutter **90**, the shutter **90** is locked (secured) to the housing **81** of the developer container **80** at the closing position where the shutter **90** closes the supply port **82**.

The unit housing **70** includes the elastic anchorage part **73** provided on the R**2** side of the recess **76**. The elastic anchorage part **73** includes a biasing portion **73***b* formed on the tray **71** and a contact portion **73***a*, which is configured to come in contact with the protrusion **91** of the shutter **90**. The contact portion **73***a* and the biasing portion **73***b* may be integrally formed with an elastic material, or the contact portion **73***a* may be fixed to the biasing portion **73***b* formed of an elastic material. Note that the elastic anchorage part **73** is omitted in FIG. **35** described above.

FIGS. **42**A and **42**B are diagrams illustrating a second stage of the attaching operation of the developer container **80**. FIG. **42**A illustrates the end of the developer container **80** in the X direction, and FIG. **42**B illustrates the central area of the developer container **80** in the X direction, i.e., the area including the supply port **82**.

As illustrated in FIG. **42**A, the developer container **80** is moved toward the unit housing **70** in the −Z direction while inserting (engaging) the guide ribs **72***a* of the unit housing **70** into the lock grooves **83** of the developer container **80**. That is, the guide rib **72***a* enters through the opening **83***a* of the lock groove **83** into the lock groove **83**. At this stage, the shutter **90** is still in the closing position where the shutter **90** closes the supply port **82**, as illustrated in FIG. **42**B.

FIGS. **43**A and **43**B are diagrams illustrating a third stage of the attaching operation of the developer container **80**. FIG. **43**A illustrates the end of the developer container **80** in the X direction, and FIG. **43**B illustrates the central area of the developer container **80** in the X direction, i.e., the area including the supply port **82**.

By further moving the developer container **80** in the −Z direction, the guide rib **72***a* of the unit housing **70** is completely inserted in the lock groove **83**, as illustrated in

FIG. **43**A. Also, as illustrated in FIG. **43**B, the bottom **81***b* of the developer container **80** is contact with the tray **71** of the unit housing **70**. With this, the developer container **80** is rotatably held on the tray **71** of the unit housing **70**.

Also, the protrusion **91** of the shutter **90** comes in contact with the contact portion **73***a* of the elastic anchorage part **73** of the unit housing **70**, which presses the elastic anchorage part **73** down in the −Z direction, compressing the biasing portion **73***b* of the elastic anchorage part **73**.

FIGS. **44**A and **44**B are diagrams illustrating a fourth stage of the attaching operation of the developer container **80**. FIG. **44**A illustrates the end of the developer container **80** in the X direction, and FIG. **44**B illustrates the central area of the developer container **80** in the X direction, i.e., the area including the supply port **82**.

By rotating the developer container **80** in the R**1** direction, the arc-shaped lock portion **83***b* of the lock groove **83** of the developer container **80** comes in contact with the −Z side end of the guide rib **72***a* of the unit housing **70**, as illustrated in FIG. **44**A. With this, the developer container **80** is secured so that the developer container **80** cannot be removed from the unit housing **70**.

Also, as illustrated in FIG. **44**B, the shutter side contact portion **92** of the shutter **90** comes in contact with the unit side contact portion **75** of the unit housing **70**, and the protrusion **91** of the shutter **90** enters the recess **76** of the unit housing **70**. With this, the rotation of the shutter **90** in the R**1** direction with respect to the unit housing **70** is restricted.

In addition, the lock release post **74** (FIG. **35**) of the unit housing **70** comes in contact with the contact portion **86***a* (FIG. **38**) of the latch **86** of the developer container **80**, causing the latch **86** to be deflected. With this, the engagement between the latch **86** of the developer container **80** and the projection **96** (FIG. **35**) of the shutter **90** is released, and thus the shutter **90** becomes rotatable relative to the housing **81** of the developer container **80**.

FIGS. **45**A and **45**B are diagrams illustrating a fifth stage of the attaching operation of the developer container **80**. FIG. **45**A illustrates the end of the developer container **80** in the X direction, and FIG. **45**B illustrates the center area of the developer container **80** in the X direction, i.e., the area including the supply port **82**.

As illustrated in FIG. **45**A, by further rotating the developer container **80** in the R**1** direction, the stopper portion **83***c* of the lock groove **83** comes in contact with the side surface of the guide rib **72***a* in the rotational direction. This restricts the rotation of the developer container **80** relative to the unit housing **70** in the R**1** direction. In other words, the developer container **80** reaches the installed position.

Also as illustrated in FIG. **45**B, since the movement of shutter **90** in the R**1** direction is restricted, the housing **81** of the developer container **80** is rotated in the R**1** direction with leaving the shutter **90** behind, which causes the supply port **82** to be opened. In other words, the shutter **90** rotates relative to the housing **81** of the developer container **80** in the R **2** direction, so as to open the supply port **82**. As a result, the supply port **82** of the developer container **80** and the reception port **77** of the unit housing **70** are aligned with and connected to each other. With this, the developer in the developer container **80** can be supplied from the supply port **82** to the reception port **77**.

In this state, when the gear **802** (FIG. **35**) is rotated by the drive gear in the image formation apparatus **1**A, the agitating member **801** rotates. This agitates the developer in the developer container **80** and transports the developer from the supply port **82** to the reception port **77**. The developer transported to the reception port **77** is supplied to the image formation unit **110** (FIG. **33**). In other words, the image formation apparatus **1**A becomes ready for performing a printing operation with the developer.

(Detaching Operation of Developer Container **80**)

Next, an operation of detaching (removing) the used developer container **80** from the unit housing **70** is described. FIGS. **46**A to **46**C are diagrams of cross sectional views illustrating a first stage, a second stage, and a third stage of the detaching operation of the developer container **80**, respectively. FIGS. **46**A to **46**C all illustrate the cross sectional views of a portion of the developer container **80** that includes the supply port **82**.

In a state where the developer container **80** is used up, i.e., where all the developer in the developer container **80** is discharged, as indicated by a reference sign T**1** in FIG. **46**A, the developer is adhered to the inner wall surfaces of the supply port **82**, the sealing member **88**, and the reception port **77**.

In the state the developer container **80** is in the installed position, the movement of the shutter **90** in the −X direction is restricted by the engagement between the inclined portion **98** of the shutter **90** and the elastic anchorage part **73**.

Therefore, as illustrated in FIG. **46**B, when the developer container **80** is rotated in the R**2** direction, the housing **81** of the developer container **80** is rotated in the R**2** direction while the shutter **90** is left behind. In other words, the shutter **90** moves relative to the housing **81** of the developer container **80** in the R**1** direction and thereby closes the supply port **82**.

As the developer container **80** rotates in the R**2** direction, the inner wall surfaces of the supply port **82** of the developer container **80** on the upstream side and the downstream side in the R**2** direction pass over the shutter side contact portion **92**. With this rotation operation, the developer that is adhered to the inner wall surfaces of the supply port **82** is scraped off by the shutter side contact portion **92** and thus is adhered to the shutter side contact portion **92** as illustrated by the reference sign T**2**.

When the shutter **90** reaches the closing position where the shutter **90** closes the supply port **82**, the latch **86** (FIG. **35**) of the developer container **80** is engaged with the projection **96** of the shutter **90**, and also the stopper **85** of the developer container **80** comes in contact with the stopper surface **95***a* (FIG. **40**) of the shutter **90**. This regulates the movement of the shutter **90** relative to the housing **81** of the developer container **80**. In other words, the shutter **90** gets in the state where the shutter **90** moves integrally with the housing **81** of the developer container **80**.

Although the inclined portion **98** of the shutter **90** is in contact with the elastic anchorage part **73** of the unit housing **70**, when the force F**3** applied by the user by pulling the developer container **80** is greater than the force F**4** that the inclined portion **98** receives from the elastic anchorage part **73** (F**3**>F**4**), the biasing portion **73***b* of the elastic anchorage part **73** is compressed to release the rotation restriction of the shutter **90**. With this, the developer container **80** (including the shutter **90**) is allowed to rotate in the R**2** direction.

Next, as illustrated in FIG. **46**C, when the developer container **80** is further rotated in the R**2** direction, the shutter side contact portion **92** of the shutter **90** is separated away from the unit side contact portion **75** in the R**2** direction and the protrusion **91** of the shutter **90** comes out of the recess **76** of the unit housing **70** in the R**2** direction.

In this rotation operation, a portion of the developer T**2** that is adhered to the shutter side contact portion **92** falls and is then adhered onto the flat portion **91***a* of the protrusion **91** as illustrated by the reference sign T**3**.

In this state, as illustrated in FIG. **42**A described above, the guide rib **72***a* of the unit housing **70** has been separated from the lock portion **83***b* of the lock groove **83** and reached the opening **83***a* of the lock groove **83**. Therefore, by lifting the developer container **80** in the +Z direction, the developer container **80** can be removed from the unit housing **70**.

That is, the developer container **80** is removed from the unit housing **70**, with the developer T**2** being adhered to the shutter side contact portion **92** and the developer T**3** being adhered onto the flat portion **91***a* of the protrusion **91**.

Since the developer container **80** is removed with the developer T**2** being adhered to the shutter side contact portion **92** and the developer T**3** being adhered to the flat portion **91***a* of the protrusion **91**, this prevents the surroundings of the developer container **80** from being contaminated with the developer.

FIG. **47** is a diagram illustrating the vicinity of the supply port **82** of the developer container **80** in the state where the developer container **80** is in the installed position (FIG. **45**B). When the protrusion **91** of the shutter **90** is engaged with the recess **76** of the unit housing **70**, the flat portion **91***a* of the protrusion **91** is in contact with the top surface **76***a* of the recess **76**. As a result, the distance between the housing **81** of the developer container **80** and the unit housing **70** is kept constant.

Therefore, as illustrated in FIGS. **44**B and **45**B, the sealing member **88** passes over the unit housing **70** with the sealing member **88** being pressed between the housing **81** and the unit housing **70**. Therefore, the amount of the developer that is adhered onto the protrusion **91** when the developer container **80** is removed can be reduced. Also, as in explained in a first embodiment with reference to FIGS. **26**A to **27**B, when a new developer container **80** is installed into the unit housing **70** from which one or more used developer containers **80** have been removed, the developer remaining around the reception port **77** of the unit housing **70** can be efficiently removed.

The distance L**2** by which the recess **76** is recessed in the R**1** direction from the unit side contact portion **75** is greater than the distance L**1** by which the protrusion **91** protrudes in the R**1** direction from the shutter side contact portion **92**. Therefore, with the shutter side contact portion **92** and the unit side contact portion **75** in contact without any gap, the protrusion **91** can be engaged with the recess **76**.

(Effects of Second Embodiment)

As explained above, in a second embodiment, the developer container **80** includes the shutter **90** (the opening/closing member) configured to open and close the supply port **82** of the housing **81** and the sealing member **88** provided between the housing **81** and the shutter **90**. The shutter **90** includes: the cover portion **93** including the cover surface **93***a* configured to close the supply port **82** of the developer container **80**; and the protrusion **91** (the protruding portion) protruded from the cover portion **93** in the R**1** direction (in the attaching direction of the developer container **80**). The protrusion **91** is provided at the position spaced away from the cover surface **93***a* toward the unit housing **70**. The unit housing **70** includes the recess **76** (the engagement portion) that is configured to be engaged with the protrusion **91** of the shutter **90** in the state where the developer container **80** is installed (attached) to the unit housing **70**.

According to a second embodiment, since the shutter **90** includes the protrusion **91**, when the developer container **80** is removed from the unit housing **70**, the developer that falls from the inner wall of the supply port **82** during the removal of the developer container **80** is retained on the protrusion **91** of the shutter **90**. This prevents the developer from spilling out of the developer container **80**. In other words, it is possible to prevent the surroundings of the developer container **80** from becoming contaminated with the developer.

Further in a second embodiment, at a certain point after the protrusion **91** and the recess **76** are engaged and before the supply port **82** and the reception port **77** are opposed (aligned) to each other in the course of attaching the developer container **80**, a part of the recess **76** (the top surface **76***a* of the recess **76**) is located between the protrusion **91** and the sealing member **88**. Thus, the amount of the developer that is adhered to the protrusion **91** during the removal of the developer container **80** can be reduced.

Further in a second embodiment, in the state where the protrusion **91** of the shutter **90** is engaged with the recess **76** of the unit housing **70**, the developer container **80** is moved to the installed position (the position where the supply port **82** and the reception port **78** are aligned with each other) so as to open the supply port **82** with the shutter **90**. With this configuration, the shutter **90** is only opened when the supply port **82** and the reception port **77** are opposed to each other, which may reliably prevent the leakage of the developer.

(Modification)

Next, a modification of a second embodiment is described. FIG. **48** is a diagram illustrating an engagement section between the developer container **80** and the unit housing **70** according to a modification.

In a second embodiment (FIG. **47**), the flat portion **91***a* of the protrusion **91** is horizontal, i.e., parallel to the X-Y plane in the state where the protrusion **91** is engaged with the recess **76**. To the contrary, in a modification illustrated in FIG. **48**, in the state where the protrusion **91** is engaged with the recess **76**, the flat portion **91***a* of the protrusion **91** is inclined with respect to the X-Y plane such that the flat portion **91***a* is displaced in the −Z direction as advancing in the R**2** direction (i.e., as approaching the shutter side contact portion **92**).

In illustrated in FIG. **48**, in the state where the protrusion **91** is engaged with the recess **76**, a lowest point, in the vertical direction, of a surface of the protrusion **91** on the developer container **30** side is referred to as a lowest point B of an upper surface of the protrusion **91**. A certain area C of the upper surface of the protrusion **91** that is positioned on the R**1** side (in the first direction) with respect to the lowest point B of the upper surface of the protrusion **91** is located upper in the vertical direction than the lowest point B of the upper surface of the protrusion **91**. The area C of the protrusion **91** is, for example, a contact portion configured to come in contact with the top surface **76***a* of the recess **76**.

With this configuration, the developer that is scraped off by the unit side contact portion **75** and falls onto the flat portion **91***a* during the removal of the developer container **80** is guided to a side of the flat portion **91***a* closer to the unit side contact portion **75** (guided to a proximal side of the flat portion **91***a*).

Therefore, even after the developer container **80** is removed from the unit housing **70**, the developer is held at the proximal side of the flat portion **91***a* of the protrusion **91** and thus is not likely to spill out. As a result, the effect of preventing the surroundings of the developer container **80** from becoming contaminated with developer can be enhanced.

In a modification described above, the case has been described in which the flat portion **91***a* of the protrusion **91** is inclined. However, a hole as in the hole **41***c* illustrated in FIG. **31** may be provided between the flat portion **91***a* of the

protrusion **91** and the shutter side contact portion **92** (i.e., on the R**2** side with respect to the flat portion **91***a*).

Further, an inclined portion, such as the inclined portion **26***b* illustrated in FIG. **30**, may be provided between the top surface **76***a* of the recess **76** and the unit side contact portion **75** of the unit housing **70**.

Furthermore, the supply port **82** of the developer container **80** may be provided with an inclined portion, such as the inner wall surface **32***a* illustrated in FIG. **32**B.

Although one or more embodiments and modifications have been described above, the disclosure is not limited thereto, and various improvements or modifications can be made. Each of one or more embodiments and modifications can be combined as appropriate.

Although in one or more embodiments and modifications described above, the case has been described in which a printer is an example of an image formation apparatus. However, one or more embodiments and modifications described above can be also used in copiers, facsimiles, MFPs (multi-functional peripherals), etc. as an image formation apparatus.

The invention includes other embodiments or modifications in addition to one or more embodiments and modifications described above without departing from the spirit of the invention. The one or more embodiments and modifications described above are to be considered in all respects as illustrative, and not restrictive. The scope of the invention is indicated by the appended claims rather than by the foregoing description. Hence, all configurations including the meaning and range within equivalent arrangements of the claims are intended to be embraced in the invention.

The invention claimed is:

1. A developer supply device comprising:

a developer container including a housing with a supply port, and containing a developer therein; and

a developer container holder that includes a reception port to receive the developer supplied from the supply port of the developer container, and to which the developer container is to be attached in a first direction, wherein

the developer container includes:

an opening/closing member movable relative to the housing between a closing position where the opening/closing member closes the supply port and an opening position where the opening/closing member opens the supply port; and

a sealing member provided between the housing and the opening/closing member,

the opening/closing member includes:

a cover portion including a cover surface configured to close the supply port; and

a protruding portion projected in the first direction from the cover portion and provided at a position spaced apart from the cover surface to a side of the developer container holder,

the developer container holder includes an engagement portion configured to be engaged with the protruding portion in a state where the developer container is attached to the developer container holder, and

a part of the engagement portion is located between the protruding portion and the sealing member at a point after the protruding portion of the opening/closing member is engaged with the engagement portion of the developer container holder and before the supply port of the developer container and the reception port of the developer container holder are opposed to each other in a course of attaching the developer container to the developer container holder.

2. The developer supply device according to claim **1**, wherein

the opening/closing member is configured to open the supply port, by moving the developer container to a position where the supply port and the reception port are opposed to each other in a state where the protruding portion is engaged with the engagement portion.

3. The developer supply device according to claim **1**, wherein

the opening/closing member includes a first contact portion,

the developer container holder includes a second contact portion, and

the first contact portion and the second contact portion are configured to be opposed to and in contact with each other in the first direction after the protruding portion is engaged with the engagement portion until the supply port and the reception port are opposed to each other.

4. The developer supply device according to claim **3**, wherein

the engagement portion of the developer container holder includes a recess that is provided on a side opposite to the housing of the developer container with respect to the second contact portion and is recessed in the first direction than the second contact portion, and

the protruding portion is configured to inserted in the recess when the protruding portion and the engagement portion are engaged with each other.

5. The developer supply device according to claim **4**, wherein

a distance by which the recess is recessed in the first direction than the second contact portion is greater than a distance by which the protruding portion protrudes in the first direction than the first contact portion.

6. The developer supply device according to claim **4**, wherein

the protruding portion includes a first inclined portion that is inclined such that the first inclined portion slopes away from the housing as advancing in the first direction,

a second inclined portion provided to be opposed to the first inclined portion is formed between the second contact portion and the recess, and

the first inclined portion and the second inclined portion are configured, when the protruding portion is engaged with the engagement portion, to come in contact with each other thereby bringing the developer container and the developer container holder closer together.

7. The developer supply device according to claim **3**, wherein

the protruding portion is protruded in the first direction from a portion of the cover portion on the side of the developer container holder with respect to the first contact portion, and

a surface of the protruding portion on a side of the developer container includes a hole.

8. The developer supply device according to claim **1**, wherein

the developer container is elongate in a longitudinal direction thereof parallel to the first direction, and the developer container is configured, by being moved in the longitudinal direction of the developer container, to be attached to an installed position of the developer container to the developer container holder.

9. The developer supply device according to claim 1, wherein

the developer container is elongate in a longitudinal direction thereof, and the developer container is configured, by being rotated about a rotation axis thereof extending in the longitudinal direction of the developer container, to be moved to an installed position of the developer container to the developer container holder, and

the first direction is a rotation direction about the rotation axis of the developer container.

10. The developer supply device according to claim 9, wherein

in a state where the protruding portion is engaged with the engagement portion, a lowest point, in a vertical direction, of a surface of the protruding portion on a side of the developer, is referred to as a lowest point of a first surface of the protruding portion, and

a certain area of the first surface of the protruding portion that is on a side of the first direction with respect to the lowest point of the first surface is provided above than the lowest point of the first surface in the vertical direction.

11. A development device comprising:

the developer supply device of claim 1.

12. An image formation apparatus comprising the developer supply device according to claim 1.

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